THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 18 OCTOBER, 1939 Number 10

F. M. LOCKE

For story, see pages 404–408

Ancient Kiln Tender with his hour glass. Reproduced by special permission of The Victoria and Albert Museum of London. From Cipriano Piccolpasso's classic book on the Potter's Art (1524–1579).

It is a far cry from the ancient ceramic procedure shown above to the modern, continuously-fired electric gas, and oil tunnel kilns, with their elaborate controls of temperature and atmospheric conditions.

Scientific methods of mixing, processing, and firing have almost entirely eliminated the part that Lady Luck plays in the ceramic industry, whereas the pioneer courted her Ladyship sincerely and called on Heaven as well.

However, customers' demands have grown as exacting as the industry has become efficient, and harassed present-day ceramists enjoy with sympathetic appreciation the earnest appeal to Divinity that accompanied early kiln-firing.

In three volumes filled with the most minute description of materials, exact instructions for their preparation and detailed drawings of each piece of equipment, Cipriano Piccolpasso concluded his remarks on firing as follows:

"When all this has been done, prayers are offered to God with all the heart, thanking Him always for all that He gives. Fire is brought, care being taken to observe the state of the moon, because this is of the greatest importance, and I have heard from those who are old in the art and of some experience that if the firing happens to take place at the waning of the moon, the fire lacks brightness in the same manner as the moon its brilliance. In doing this, therefore, care should be taken to watch for the signs of rain, which would be highly dangerous and must be allowed to pass over, remembering always to do all things in the name of Jesus Christ . . ."

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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

Volume 18 October, 1939 Number 10

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Publication Office: 20th & Northampton Sts., Easton, Pa.
Editorial and Advertising Office: 2525 N. High St., Columbus, Ohio.
Executive Office: 2525 N. High St., Columbus, Ohio.
Committee on Publications: J. D. Sullivan, *Chairman;* E. E. Marbaker, A. N. Finn, W. W. Winship, Ross C. Purdy.

Entered as second-class matter at the post office at Easton, Pa., under the act of March 3, 1879. Published monthly.
Subscription $1.50 a year. Single numbers twenty-five cents.
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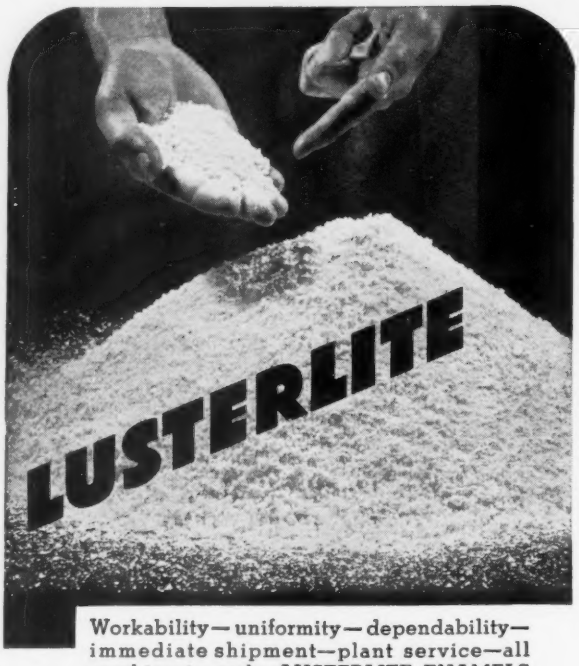

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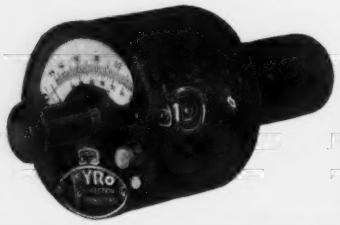

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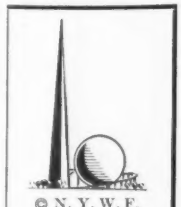

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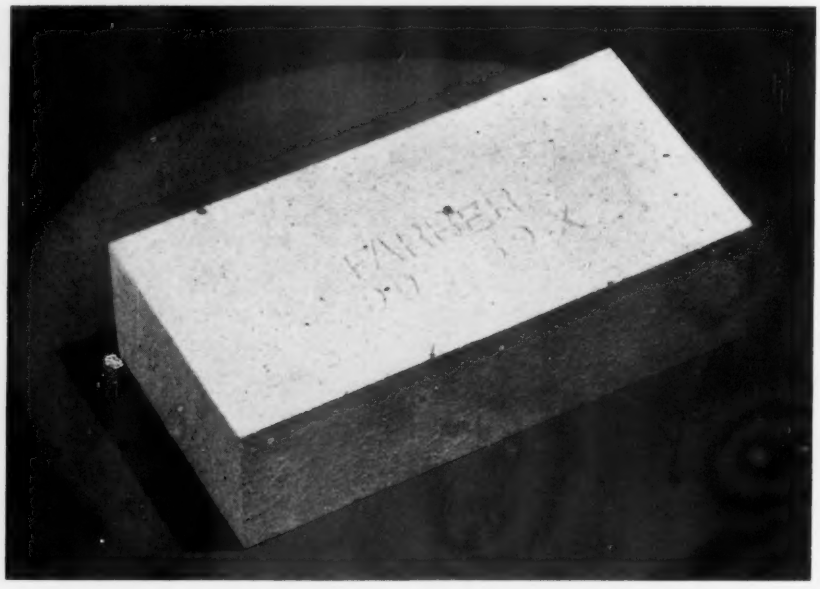

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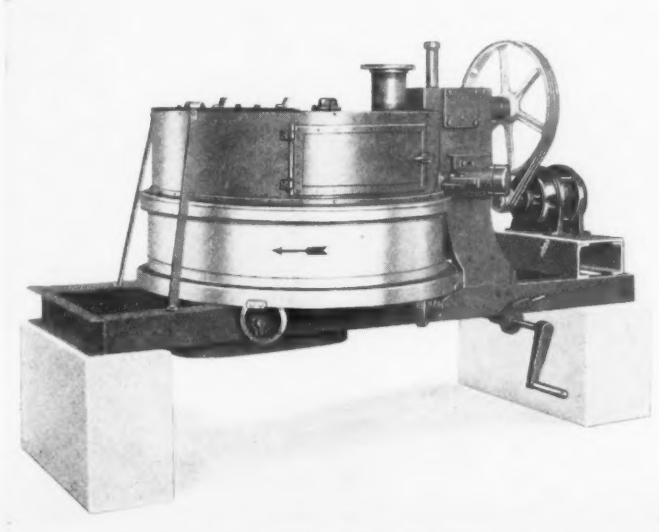

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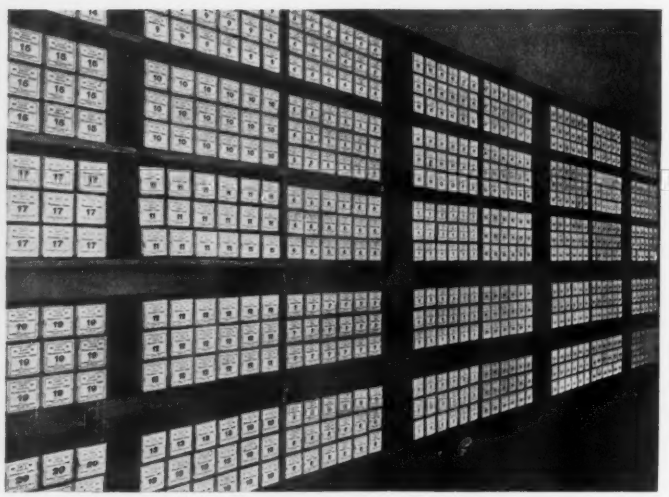

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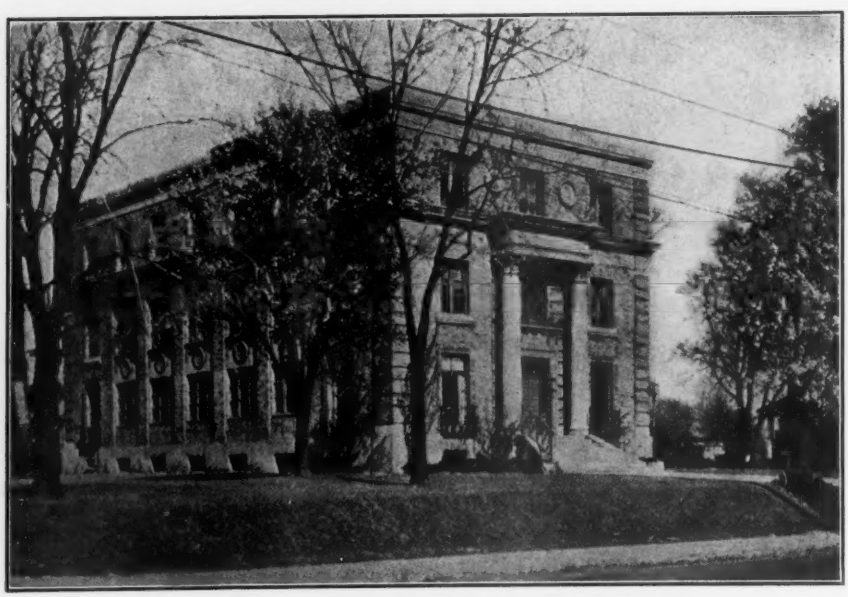

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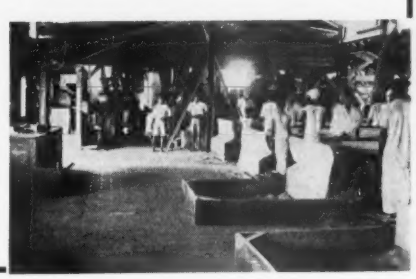

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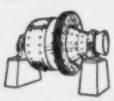
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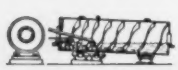
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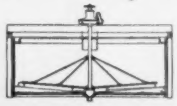
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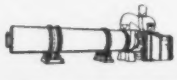
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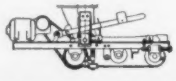
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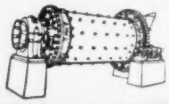
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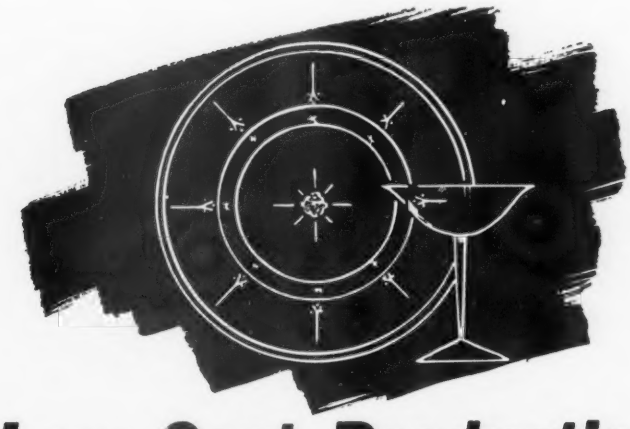

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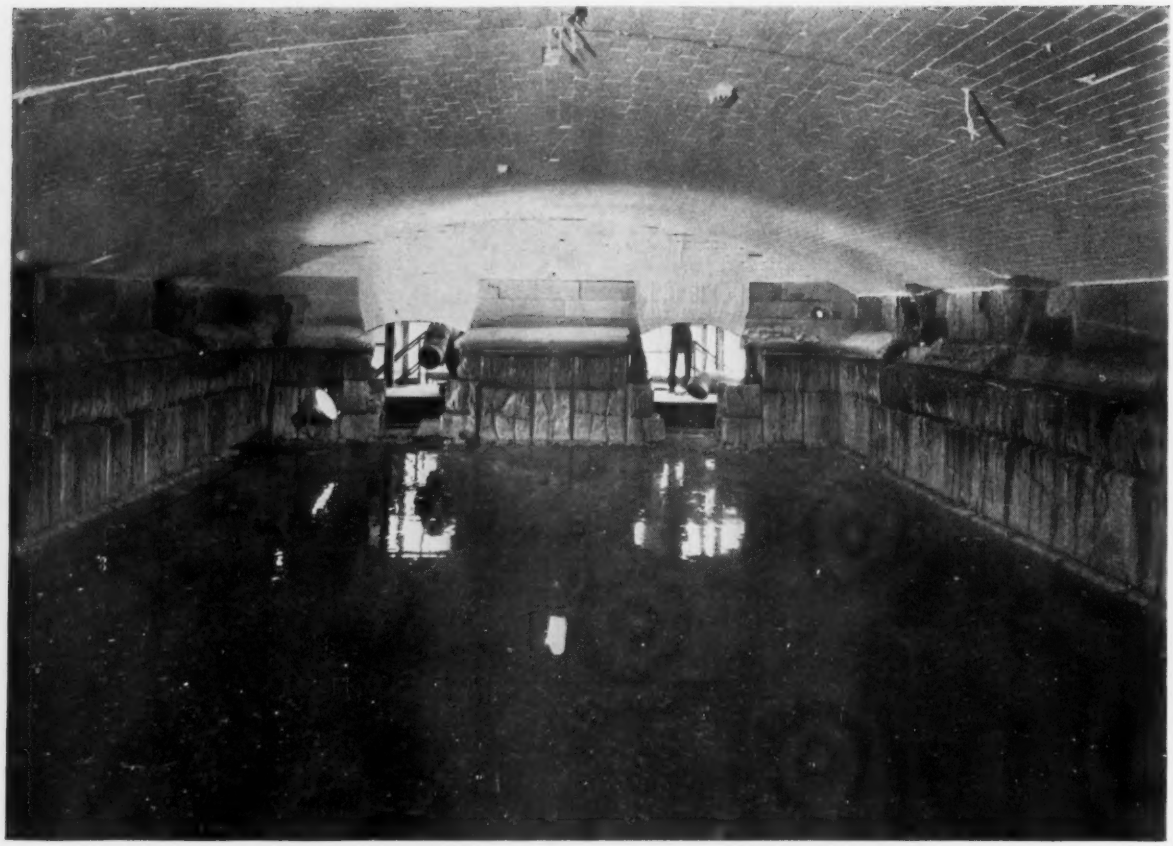

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A Monthly Publication Devoted to Proceedings of the Society and Promotion of Coöperative Research of Technical, Scientific, and Art Questions

Volume 18 **OCTOBER, 1939** **Number 10**

PAPERS

PRELIMINARY STUDY OF WETTING AGENTS IN GROUND-COAT ENAMELS*

By D. J. Benoliel

I. Introduction

This study of wetting agents in the porcelain enamel field up to six months ago had been entirely confined to their use with alkaline cleansers. At the second meeting of the Porcelain Enamel Institute, however, several members thought that wetting agents might be applied to ground coats and suggested that work be done on this problem. The coöperation of a member at one of the large plants was secured, and the wetting agents that had shown promise were sent to him.

As an approach to the problem, it was decided to find to what degree a wetting agent affects (1) the firing, (2) the bond, (3) the boiling tendency, (4) the adherence, and (5) the maturing time of a ground coat, *i.e.*, is it possible to have a one-minute bake at 1600°F instead of a four-minute bake? Furthermore, if a wetting agent is used, will less enamel be used with (6) greater coverage, (7) fewer bare spots, and (8) less fish-scaling?

As a first step, a mixture of sulfonated fatty alcohols, known as TF-720, was tried, which gave such excessive "sudding" in the preparation of the ground coat that its use was not practical. Four other wetting agents were tested, *viz.*, (1) sodium salt of isopropyl alcohol, naphthalene, and sulfonic acid (TF-824); (2) sulfonated benzol derivative compounded with a fatty acid soap (No. 700-X); (3) ricinoleic acid ester with 13% combined SO_3 on a dry basis (Pro-So-Tex No. 53); and (4) 75% sulfonated castor oil containing 8% combined SO_3 on a dry basis. Three of these wetting agents were liquid and one was a powder. The powder and one of the liquids, No. 700-X, have fairly strong odors which in some cases may be objectionable. It was necessary to heat the powder, TF-824, in distilled water to get it in suspension.

II. Procedure

A 40% solution was made up of each of the liquids, and in the case of the powder, an approximate 10% solution of 100 cc. of distilled water and 10 grams of the powder, TF-824.

Three different concentrations of wetting agent were used, the liquids at 0.1, 0.25, and 0.5% and the powder at 0.025, 0.62, and 0.125%.

Panels, 9 by 12 inches, were pickled and treated at selected areas either with 300-viscosity mineral oil or vegetable oil soap.

Approximately 2 cc. of each of the solutions were allowed to run from a pipette across the surface of the pickeled panels at the designated points. The panels were allowed to stand for thirty minutes and then were dipped in the treated enamel so that the ground coat drained parallel to the direction of flow of the oil or soap solutions across the surface.

To 4000 cc. of milled ground-coat enamel at a dipping weight of 39 grams per sq. ft. (or 48 grams wet weight on a 9- by 12-inch panel) the wetting agent was added and thoroughly stirred. A pickled panel was dipped in the enamel and weighed to determine the effect of the addition of wetting agent on dipping weight and draining.

Panels, 9 by 12 inches, pickled and treated with various concentrations of 300-viscosity mineral oil in petroleum ether or vegetable oil soap in distilled water, were dipped in the ground coat to which the wetting agent had been added. The effect of the wetting agent on the draining of the ground coat and on its ability to cover oil or soap streaks was observed, as well as the dried and fired appearance of the panels.

III. Results

There was no distinct difference in the wetting power of treated over untreated ground coat.

The addition of wetting agents to the ground coat in each case caused suds to form on stirring. Bubbles of suds which remained on the panels in the dipping process would break and leave a bare metal spot. Pro-So-Tex No. 53 and 75% sulfonated castor oil showed the least suds-forming tendency. Pro-So-Tex No. 53 however, caused streaking in the ground coat on draining.

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 29, 1938 (Enamel Division). Received May 24, 1938.

Ground-coat set was influenced by all four of the agents. (1) TF-824 had a decided tendency to set up the ground coat at all concentrations tried, the maximum (0.15%) giving a decided increase. (2) No. 700-X increased the ground-coat set at concentrations as high as 0.25%; percentages higher than 0.25% resulted in a decrease in set. (3) Pro-So-Tex No. 53 and (4) 75% sulfonated castor oil decreased ground-coat set at all concentrations used.

One per cent of any of the liquid wetting agents caused almost complete loss of set.

TABLE I

DIPPING WEIGHTS

Concentration (%)	Wet weight on panel (9 x 12 in.) (g.)	(g./sq. ft.)
TF-824		
0.0125	48.5	64
.025	49.5	65
.062	47.0	62.7
.125	67.0	89.3
.250	Extreme set	
No. 700-X		
0.05	50.5	67.3
.10	57.5	76.7
.25	64.5	86.0
.50	53.5	71.3
1.00	Almost complete loss of set	
Pro-So-Tex No. 53		
0.05	39.5	52.7
.10	36.5	48.7
.25	29.5	39.4
.50	No data	
1.00	Almost complete loss of set	
75% sulfonated castor oil		
0.05	44.5	59.3
.10	43.5	58.0
.25	29.0	38.6
.50	20.5	27.4
1.00	Almost complete loss of set	

Ground coats which were untreated or which contained TF-824 or No. 700-X set up (*i.e.*, drained heavy) over vegetable oil soap streaks; the addition of Pro-So-Tex No. 53 or 75% sulfonated castor oil caused them to drain thin over soap streaks.

Owing to some variation in the amount of oil or soap remaining on the panels, differences occurred in the draining of two panels which had been given the same treatment. Bare metal spots or streaks which showed up on ground-coat draining and in the dried state did not noticeably increase in size on firing whether the panel had been dipped in treated or untreated ground coats.

Oil streaks covered by the treated and untreated ground coats showed little tendency to crack or crawl after firing. If the ground coat was wet through by oil when the panel was dried, the areas showing oil either fired out or showed a network of fine dark lines, regardless of whether or not the ground coat had been treated.

Copperheads were formed over vegetable oil soap streaks on panels dipped in ground coats which had been treated with enough wetting agent to reduce the set materially.

IV. Conclusions

The results from this work do not indicate that the addition of a wetting agent to ground-coat enamel increases its wetting power to a noticeable degree. A more accurate method of testing for wetting power, however, might show an advantage of the use of wetting agents.

Because all wetting agents affect the set of the enamel, their use would require special set-up additions in ground-coat milling, but they do not seem to influence the firing, the bond, or the boiling tendency of the ground coat.

QUAKER CHEMICAL PRODUCTS CORPORATION
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OBSERVATIONS ON HAIRLINES*

BY W. A. DERINGER

ABSTRACT

The hairline problem is discussed in relation to the factors which bring about this defect. The factors considered are the design of the piece, the ground-coat enamel, the firing conditions, the heat distribution during the firing cycle, the weight of application of the ground coat, the metal base, and the cover-coat enamel.

I. Introduction

One of the most thought-provoking problems confronting those engaged in the enameling industry is the question of eliminating hairlines. This defect is a common one, and it is different from other enameling defects in that the tendency to hairline is closely related to the design of the piece. It is impossible, furthermore, to predict exactly where a new design will show this defect. There are certain factors and conditions, however, which tend to affect this condition. Some of these factors are (1) design of the piece, (2) ground-coat enamel formula, (3) firing conditions, including the fixtures used and the position of ware in the furnace, (4) comparative rates of heating and cooling of different parts of piece, (5) weight of application of ground coat, (6) metal base, and (7) cover-coat enamel.

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 30, 1938 (Enamel Division). Received March 30, 1938.

II. Design of the Piece

A design suitable for enameling is often not the best design from the "sales appeal" viewpoint. The modern trend in designing calls for flat areas bounded by sharp radii and decorated with sharp embossings as contrasted with earlier designs which embodied the principle that gradual curves were the essence of all beauty. This trend brings with it the following conditions: (*a*) deep, sharp recesses and depressions, which tend to accumulate enamel dust when the ground coat is sprayed; the ground-coat application becomes excessive in these depressions, and hairlining, owing to the heavy ground coat, often results; (*b*) drawing the sheet into the form of the finished piece results in many severe strains at points where the metal has the greatest distortion. It is often impossible to complete the forming operations without local annealing at the points of greatest strain to prevent breakage in the succeeding operations. The severe stretching of the metal at these points often produces an excess of metal in adjoining flat areas, which produces an "oil-can-bottom" effect. This excess metal is distorted in firing the ground and cover coats, and the flexing of the metal in the fire frequently produces hairlines. This type of hairline is difficult to cover with repeated coats of enamel because each time the piece is fired flexing and bending of the metal takes place which fractures the enamel at the old break.

III. Ground-Coat Enamel Formula

A ground-coat enamel formula developed to minimize hairlines is one of the strongest defenses against this defect. Some ground coats which work fine on flatware and fire to a beautiful glossy finish are sure to bring disastrous results on ware which has a tendency to hairline. These ground coats have a better appearance after the ground-coat fire than those of the hairline-resisting type, but when the cover coat is applied, they hairline so badly that even repeated cover coats do not conceal this defect.

Ground coats that tend to minimize or eliminate hairlines are somewhat more refractory than other ground coats, partly due to the presence of an appreciable quantity of silica or feldspar, which also gives a broader firing range to the ground coat. The presence of this material causes the ground coat to have an open, grainy, or porous-looking texture when fired; this grainy texture evidently permits a greater thermal shock before the enamel fractures.

IV. Firing Conditions

There are apparently two schools of thought concerning the proper firing of the ground coat to curtail or to prevent hairlines, *viz.*, those who believe (1) that the ground coat should be fired hard because underfired ground coats are apt to hairline and (2) that the ground coat should be fired to a deep blue color at a comparatively low temperature. The low temperature, it is believed, does not permit the base metal to become distorted, and the soft fire does not drive off the gas-bubble formation. This bubble formation adds to the open texture imparted by the silica to give an enamel greater elasticity and greater resistance to thermal shock.

Each specific case calls for its own particular treatment, although the importance of the fire itself seems to be less important than the location of the ware in the furnace or the firing fixture used. To prevent local underfiring and to insure the ware against having heating and cooling strains in the same locality on the piece each time it is fired, it is often wise to change the position of the pieces on the fork each time the pieces are fired.

The design of the firing fixture is of vital importance. It must support the piece without distorting it, and yet it must be lightweight and so designed that there is no heavy metal section near the ware.

V. Comparative Rates of Heating and Cooling of Different Parts of the Piece

Before hairlines appear, there must be a strain in the enamel of sufficient magnitude to fracture the enamel. There are at least three strain-producing sources, *viz.*, (1) strains produced in the metal base when the piece is formed; (2) those caused by (*a*) flexing of the piece owing to the presence of excess metal, (*b*) an actual sagging of the piece between points of support in the fire, or (*c*) a pushing up of the metal by the burning tool points or knife blades; the latter two causes ((*b*) and (*c*)) may be due to improper support in firing, overfiring, or soft base metal; and (3) strains caused by unequal rates of expansion and contraction during heating and cooling the piece in firing. The strains mentioned under (1) and (2) have already been discussed. A discussion of strains of type (3) follows.

Many designs embody a flat area bounded by a crimped, embossed, or flanged edge. The flat area naturally will heat and cool at a more rapid rate than the heavier sections of the flange or curl. At any time during the heating period, this flat area is under compression and tends to flex at the corner where the flat area joins the flange because this is the point of maximum strain. This condition is present in some designs of table tops and drainboards. A similar condition but one not so readily analyzed is hairlining found in the corners of the bowl of a drainboard sink. The sides of the bowl heat and cool more slowly than the bottom of the bowl and the drainboard. The roll of the sink also tends to heat and cool more slowly than the drainboard. It is natural, therefore, that a sink should tend to line at the front top corners of the bowl where the drainboard, roll, and sides of the bowl meet.

Hairlines caused by this unequal rate of expansion and contraction may often be overcome by spraying the back sides of the light sections with a heavy coating of enamel or by placing sheets or bars of heat-resisting metal near these lighter sections so that they will heat and cool more nearly at the same rate as the heavier sections of the piece. The "cut-and-try" method may be used to determine how much metal should be placed near the area and also how near this material should be to the ware. This procedure is called "baffling."

The first step in baffling should be to observe the cooling of the ground-coat ware after it is removed from

the furnace. The areas that turn black first are those which should be baffled in order to retard the rate of heating and cooling to coincide more nearly with the rate of heating and cooling of the adjoining portion of the piece. Flatware, which is fired suspended in the furnace, can often be baffled by hanging the pieces back-to-back a short distance apart. In this way, the pieces baffle each other. At other times, the ware may be crowded too close on the fork or furnace chain, which may cause the ware to be baffled at the wrong point and thus promote hairlining.

VI. Weight of Application of Ground Coat

An excessive application of the ground coat promotes hairlines. Some control therefore must be exercised over this operation. This is easily regulated when the ground coat is dipped by using the dip-sheet weight test to control the dip tank. The most practical procedure for ware sprayed with ground coat is to use an enamel of constant consistency, to check the spray weights of the various ground-coat sprayers at regular intervals, and to attempt to keep the weight of application at a standard, which has been determined by experience to be satisfactory. Because the ground-coat firing exercises so much influence on the tendency to hairline, the application must be uniform; the enamel otherwise would be underfired at points of excessive application and overfired where the coating is too thin.

VII. The Metal Base

The properties of the base metal which are determined by the chemical composition and grain structure influence the tendency of the piece to hairline. The hardness of the base metal as reflected by the sag test is probably the most important property. A steel which sags appreciably when fired will result in a fracturing of the enamel when the flexing takes place. Hairlines caused by sagging of the metal usually occur at the points of support of the piece, which is the point where the bending or flexing of the metal is greatest.

De-enameled ware hairlines more readily than new stampings, partly because the de-enameled ware has a greater tendency to sag.

VIII. Enamel Cover Coats

The properties of the first cover coat and second cover coat of an acid-resisting enamel, in relation to each other and to the ground coat, influence the inclination to hairline. The first cover coat at times shows few or no hairlines, but the second cover coat or acid-resisting coat may be badly hairlined. The acid-resisting coat often shows cover-coat hairlines. This may be caused by insufficient film strength in the enamel or by other working properties which may be unsatisfactory. The tendency of acid-resisting enamels to hairline generally seems to be somewhat proportional to their acid resistance. The relative elasticity, tensile strength, and coefficient of expansion of the ground coat and cover coats no doubt influence the inclination to hairline insofar as these properties of the one enamel conflict or agree with those of the coating of enamel above or beneath it.

IX. Conclusion

This discussion gives some of the factors which are influential in causing or promoting hairlines. The probable procedures to be followed in order to minimize or eliminate this defect are also discussed. No attempt has been made to prescribe a cure-all or antidote for hairlines, but some of the factors which are active in producing and eliminating this defect have been enumerated.

Hairlines are still a problem, but the writer hopes that the suggestions given here will help to solve this defect.

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INHIBITORS IN STEEL PICKLING*

By C. P. Weise

Abstract

The character of oxide scale on sheet iron and the mechanism of its removal by acid pickling are discussed. Various types of inhibitors and the mechanism of their functioning are described. One of the chief objections to the use of inhibitors in pickling enameling stock has been the effort to obtain a deep etch to aid adherence. A method is described whereby the benefits of inhibitor-controlled pickling are gained and a satisfactory etch is obtained.

I. Introduction

The general principles involved in the acid removal of scale formed on the surface of steel products through the various mill operations, which cover the rolling, forging, annealing, heat treating, or other kindred heating processes, are well known. Sulfuric acid solutions of varying concentrations are generally used to effect scale removal efficiently and economically. Although muriatic acid is somewhat more expensive, it may be also used. The choice of acids usually is determined by local pickling conditions and by other reasons peculiar to the work performed.

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 29, 1938 (Enamel Division). Received March 29, 1938.

II. Mechanism of Pickling

Ordinary mill scale in the mechanism of pickling is composed essentially of three oxides of iron, *viz.*, ferrous, ferrous ferric, and ferric oxides. Ferrous oxide lies directly next to the base metal in the formation of the scale, and the other oxides are arranged in strata with the ferric oxide (which contains the least amount of iron) forming the outside layer. The acid solubility of these oxides varies widely, the ferrous oxide being much more soluble than the oxides which form the outer components of the scale. When the scaly iron is immersed in acid, the acid penetrates through cracks in the scale layer and attacks the ferrous-oxide layer next to the base metal. When this layer is dissolved away, the less soluble part of the scale falls off and sinks to the bottom of the pickling tank as a practically insoluble residue. This explains why scale apparently is attacked from its underside when it is dislodged from the base metal by acid pickling.

Simultaneously with the action of the acid on the scale, wherever the iron base metal is exposed it is subjected to a vigorous attack by the acid, and when scale removal is complete, the acid continues its corrosive attack at a considerably faster rate. This excessive action of the acid results in (1) an unnecessary consumption of steel and acid, (2) a pitted surface on the steel which holds occluded acid and iron salt, (3) absorbed hydrogen which forms metal embrittlement, and (4) acid-laden fumes which produce corrosion and unpleasant working conditions around the pickling operation.

To confine the action of the acid to the removal of scale with a minimum of attack on the base metal, the acid-pickling bath is inhibited by the addition of a material capable of preventing or suppressing the reaction between the acid and the metallic iron. Such materials are called acid-pickling inhibitors. They are a class of compounds which, when added in relatively small amounts to a pickling bath, disperse through the solution and by their nature prevent or reduce to a minimum the undesirable features attendant to what is termed in the steel industry as "overpickling." Substances which possess acid-pickling inhibiting properties may be either of an inorganic or an organic nature and they may vary widely in their source and constitution. The inorganic materials are soluble compounds or salts of the metals which are electronegative to iron and which function by plating out a film of the metal on the iron by electrogalvanic action, thus isolating the iron from attack by the acid. These types of inorganic materials have no commercial importance as inhibitors because it is difficult to control their action as compared with inhibitors of an organic nature.

The organic materials that possess inhibiting qualities usually are bodies with complex chemical molecules of high molecular weight, and they usually form colloidal solutions in pickling mediums. Although materials of widely different chemical constitutions, such as flour and starchy materials, glue and gelatin, waste sulfite liquor, and tarry residues from petroleum refining, exhibit some inhibiting characteristics, the most effective compounds belong to certain broad classes of chemicals, such as aldehydes; nitrogen-containing compounds, such as pyridine and quinidine; sulfur-containing compounds, such as sulfides and mercaptans; and sulfur- and nitrogen-containing compounds, such as thiourea and thiozolamine.

In addition to the primary function of inhibiting the action of acid on metallic iron with the lowest cost per unit of inhibition, a satisfactory commercial inhibitor should be (1) relatively nontoxic, (2) free of objectionable odors, and (3) practically completely soluble in the acid-pickling medium; in addition it should (4) leave no undesirable residues or stains on the pickled steel, and (5) suffer no rapid disintegration or decomposition at high pickling temperatures. Modern commercial inhibitors in their liquid and powder forms should satisfy these five requirements and should also have uniformity of performance, which is obtained by controlled conditions of manufacture from selected sources of raw materials.

III. Theories of Inhibitors

There has been considerable discussion in past years as to the mechanism by which inhibitors function. Among the several theories advanced, there are two which seem to be the most plausible in their explanations of "why inhibitors inhibit." One theory is based upon the fact that if two dissimilar metals, electrically connected, are immersed into an electrolyte, an electromotive force is set up between the metals. This causes a flow of electricity through the electrolyte between the two metals. In the pickling process, metallic iron and iron oxide or scale act as the two electrodes and the acid acts as the electrolyte. Galvanic or electrolytic action starts between the base metal and the scale as soon as the acid penetrates through the pores or cracks in the scale and reaches the metallic iron. This galvanic action produces a migration of the anodically charged colloidal particles of inhibitor in the acid to the negatively charged iron surface. There the colloidal particles plate out on the surface of the metal in the form of a film of molecular thickness too minute to be visible even under high magnification. This film is effective in suppressing further galvanic action and it also removes the surface of the iron from the sphere of attack by the acid.

The other theory involves the concept that the presence of the inhibitor in the acid solution so increases the normal overvoltage of hydrogen at the base metal surface that a protective layer of nascent hydrogen gas is formed on the metal surface which prevents further direct attack of the metal by the acid.

Whatever explanation is accepted for the mechanism for inhibitor action, the fact remains that the compounds now being used in the manufacture of inhibitors do function, and they furnish the steel industry with an economical tool to avoid excessive losses of steel and acid and to improve the character of steel surfaces.

Recommendations for the amount of inhibitor to use vary with the composition of the steel to be pickled, the processing treatment the steel has received, the nature of the scale to be removed, and the subsequent operations the steel will undergo after pickling. Bessemer,

high carbon, and alloy steels usually pickle much faster than mild or basic steels, and a relatively high degree of inhibition is required to prevent excessive pickling. Lesser amounts of inhibitor are recommended for pickling automobile body sheets if a bright unetched finish is desirable; for pipe and tube where long exposure to acid is sometimes necessary; for sheet stock for tin plate; and for forgings, billets, bars, wire, and wire rods. Pickling sheet stock for galvanizing usually is accomplished with relatively small amounts of inhibitor because a surface only slightly etched is needed to promote better bonding with the zinc coating.

In the case of sheets for enameling, where the interfacial bond is between metal and vitreous enamel, the tightness of the coat is influenced by the grip that the coating material can secure on the base metal. A relatively deep etch therefore is needed in pickling this class of stock, but very little, if any, inhibitor would be used. Without an inhibitor, however, the pickling operation possesses no governor to avoid the danger of "overpickling" with its attending formation of pits, which contain occluded iron salts, carbon "smut" formation, and hydrogen embrittlement. From a theoretical standpoint, the greatest uniformity of metal surface for enameling should be obtained by pickling the sheets free of scale in a highly inhibited acid solution, followed with a second operation to develop a surface uniformly etched to the right degree.

IV. Conclusions

The basic criterion for the value of an inhibitor is its efficacy, *i.e.*, how well it is able to inhibit the acid dissolution effect on the base metal. The economy of these materials may be ascertained by laboratory tests, but the solubility of commercial steels unfortunately is inconstant and is difficult to reproduce under laboratory conditions. These tests therefore at best are only a means of indicating how an inhibitor can be expected to perform in plant practice. A practical test over a period of time will indicate results that may be translated into economies and general improvements in the pickling operations. These results will inevitably follow the use of an efficient inhibitor.

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LABORATORY AND SHOP PERFORMANCE OF NONREBOILING ENAMELING SHEETS*

By J. C. Eckel

Abstract

A study has been made to determine the flexibility of reboiling and nonreboiling enameling sheets under variations existing in enamel shop practice.

I. Introduction

The causes of reboiling in commercial enameling sheets will not be discussed here, but the writer will relate experiences with the laboratory and shop performance of nonreboiling and reboiling sheet steels. It is hoped that this presentation will stimulate further studies on this important subject.

Schaal and Fuller[1] have concluded that ground-coat reboiling is caused by the evolution of certain gases from the base metal. Hayes, Canfield, and McGohan[2] state that ground-coat reboiling results from an enamel fracture when the ground coat is refired. These fractures lead from the base metal to the surface of the enamel and from bubble to bubble, drawing air. The cracks seal at the surface with rising temperature, and the smaller bubbles later coalesce into larger bubbles near the metal base. Other investigators maintain that the gases causing reboiling are derived from the enamel itself.

It is thus apparent that those who have devoted considerable study to this subject do not agree as to the cause of reboiling.

The majority of ground-coated enameling sheets that are refired for 40 to 50 seconds at approximately 1520° to 1540°F and then cooled will show some degree of reboiling. Prolonged heating at this temperature causes the reboil bubbles to subside. Reboiling will appear again if the specimen is cooled and refired. Connelly and Lord[3] and Andrews[4] have illustrated the reboiling phenomena in their respective papers.

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Enamel Division). Received May 2, 1939.

[1] R. B. Schaal and D. H. Fuller, "Modern Enameling Troubles," *Ceram. Ind.*, **15** [6] 605–14 (1930); *Ceram. Abs.*, **10** [3] 176 (1931).

[2] Anson Hayes, J. J. Canfield, and G. W. McGohan, "Mechanism of Black-Speck Formation in Enamel Resulting from Reboiling of the Ground Coat," *Jour. Amer. Ceram. Soc.*, **15** [6] 338–44 (1932); discussions, pp. 344–53.

[3] D. S. Connelly and J. O. Lord, "Microscopic Studies of Reboiling Phenomena," *ibid.*, **20** [1] 10–16 (1937).

[4] A. I. Andrews, "Microscopic Observations of Appearance of Enamels During Firing and Reboiling," *Bull. Amer. Ceram. Soc.*, **14** [1] 18–19 (1935).

II. Reboiling Experiments

(1) Ground-Coat Tests

To determine the reboiling characteristics of different ground coats on previously determined nonreboiling enameling sheets, three ground coats were selected, *viz.:* (1) ground-coat A, medium hard, less susceptible to reboiling than B, and more susceptible than C; (2) ground-coat B, soft, violent reboiling; and (3) ground-coat C, reboils very little, if any, on any base metals.

No reboiling occurred on any of the specimens tested, irrespective of the ground coat employed.

(2) Base-Metal Tests

The effect of chemical composition of the base metal on the reboiling properties was tested, and two steels, A and B, of the following "typical analysis" were used:

Steel A	(%)	Steel B	(%)
Carbon	0.02	Carbon	0.06
Manganese	.04	Manganese	.40
Phosphorus	.009	Phosphorus	.008
Sulfur	.025	Sulfur	.016
Silicon	.008	Silicon	.009

Sheet treatment No. 1 for steels A and B: hot roll, heat-treated, pickle, cold roll to flatten.
Sheet treatment No. 2 for steels A and B: hot roll, pickle, cold reduce, heat-treated, pickle, cold roll to flatten.

Steel A reboiled regardless of treatment. The extent of the reboiling was associated with the treatment, *e.g.*, reboiling was more pronounced with sheet treatment No. 1 than with No. 2.

Steel B, when subjected to treatment No. 1, likewise reboiled, but no reboiling occurred with No. 2. These results, together with additional experiments with mild steel grades, indicate that as the carbon and manganese increase the tendency toward reboiling decreases when processed under the cold reduction method (sheet treatment No. 2).

(3) Effect of Shop Conditions

To draw comparisons between reboiling and nonreboiling steels when subjected to some enameling shop variables, the following procedure was followed:

	Shop Conditions	
Coating	Weight (g./sq. ft.)	Firing
Standard	38	Normal
Light	31	Overfired
Light	31	Underfired
Heavy	43	Overfired
Heavy	43	Underfired

All specimens were given a ground-coat enamel and then two white cover coats. The specimens were inspected and rated by five different individuals who concluded that the nonreboiling steel specimens not only were superior in appearance to the reboiling steel specimens but were less susceptible to enamel defects when subjected to the malpractice used in the experiment.

The same procedure was duplicated at another plant, and the results confirmed those given.

(4) Mild Reboiling

Schaal and Fuller[1] state that "this whole discussion seems to place with the maker of steel sheets an untold opportunity for further service to the enamel industry. Let him produce clean sheets which can be depended upon to evolve only a little gas, all in the earlier stages of heating, and black specks will disappear. So, also, will delayed fishscale."

This statement requesting "clean sheets, etc.," prompted an investigation of the performance of nonreboiling on specimens which evolve only a little gas in the early stages of heating. These specimens will be designated as mild reboiling. The results of this investigation showed that there was little difference in the performance between the nonreboiling and the mild reboiling types under proper shop practice.

(5) Black Specks

All black specks are not caused by reboiling, and several cases which have come under the personal observation of the writer were due to other causes.

To establish definitely that the black specking in one instance was not caused by reboiling, specimens of nonreboiling and reboiling metal were welded together into one piece and were processed under identical conditions. Laboratory tests were made before welding the samples together to be absolutely sure that one half the specimen was of the nonreboiling type and the remaining half of the reboiling type.

Companion samples, similar to these, were processed under the conditions prevailing in the shop, and there were as many black specks in the nonreboiling portion of the samples as in the reboiling areas. This indicated that reboiling was not the cause of the difficulty. The source of the black specking was traced to improper cleaning of the sheet surface before enameling, corrective steps were taken, and the black specks disappeared.

As Hayes, Canfield, and McGohan[2] have pointed out, there are several causes for black specks, and experience has shown that it is unwise to conclude, when this defect appears, that it is due to reboiling.

(6) Fishscaling

A sign manufacturer, in another instance, encountered serious fishscaling defects. Hansen[5] has given twelve causes for this defect, *viz.:* (1) chemical balance of enamel, (2) improper smelting, (3) improper milling, (4) character of clay used, (5) failure to stir liquid ground-coat enamel frequently, (6) character of iron, (7) improper pickling of iron, (8) underfiring, (9) overfiring, (10) type of furnace used, (11) leaking of muffle furnaces, and (12) heavy application of ground coat. Corrective measures were taken with these points in mind, but the fishscaling continued.

The writer was solicited to find a solution to the difficulty. A thorough investigation failed to reveal any faulty shop conditions. A production run of nonre-

[5] Manual of Porcelain Enameling. Edited by J. E. Hansen, Enamelist Publishing Co., Cleveland, Ohio, 1937; *Ceram. Abs.*, **17** [2] 59 (1938).

boiling and mild reboiling enameling sheets was placed on the enameling line in an effort to eliminate the fishscaling. The consumer made no changes in his practice and no further trouble was encountered.

The material on which fishscaling occurred was processed on two high-hand hot mills and showed violent reboiling characteristics.

(7) Mill Processing Sheets

Two methods are employed in the production of enameling sheets, *viz.*, (1) the hand hot-mill method and (2) the continuous cold-mill process.

Laboratory reboiling tests have been employed to determine the reboiling characteristics of enameling sheets made by the cold reduction method compared with those made by the hand hot-mill process. Those students who have studied the subject unanimously agree that the cold reduced product is either nonreboiling or mild reboiling in character, whereas the hand-mill product possesses medium to violent reboiling characteristics.

This opinion is supported by the Eckel U. S. patent 1,998,045, April 16, 1935, which provides for heavy cold reduction to prevent reboiling; the Porter and Saylor[6] U. S. patent 2,065,392, December 22, 1936, which provides for chemical additions and heavy cold reduction; and the Canfield and McGohan[2] U. S. patent 2,127,388, August 16, 1938, which resorts to drastic cold reduction to accomplish the same results.

[6] Operating and Metallurgical Division, Carnegie-Illinois Steel Corporation.

[7] L. C. Athy, Director of Research, Porcelain Enamel & Mfg. Company, Baltimore, Md., oral discussion.

Athy[7] has stated that his work on heavy cold reduction to prevent reboiling gave results similar to those of the writer.

III. Summary

The following conclusions have been drawn from the experimental and practical evidence:

(1) Sheets of the nonreboiling type show no reboiling regardless of the type of ground coat used.

(2) Chemical composition exercises an influence on the reboiling properties of sheet steel; in general, as the carbon and manganese contents increase, reboiling decreases when the sheets are processed by the cold reduction method.

(3) Nonreboiling or mild reboiling enameling steels are not as susceptible to enamel defects under malpractice in the enamel shop as is the reboiling type, and they are superior to the reboiling type under normal shop practice.

(4) Other causes for black specking in addition to reboiling are improper pickling, contaminated frits, and an unclean enamel shop.

Enameling sheets made by heavy cold reduction are either nonreboiling or mild reboiling, and the mild reboiling type, where the action occurs in the early heating periods, performs equally as well as the nonreboiling type in commercial enameling practice.

Enameling sheets made by the hand-mill process have medium-to-violent reboiling characteristics compared to the continuous-mill sheets.

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STUDY OF SOME EFFECTS OF SODIUM NITRITE IN COVER ENAMELS*

By L. A. Lange

Abstract

An investigation was conducted on the amount of sodium nitrite necessary to control tearing in a given enamel. The effect on drying rate, scumming tendency, softening point, variations in specific gravity, and behavior of reclaimed enamel was studied. A comparison was also made between adding sodium nitrite as a mill addition and as a solution after milling just before use.

I. Introduction

Sodium nitrite has been used rather generally during the past year to correct tearing when this defect was encountered. Tearing may be described as a series of short dark lines or "tears," which follow a definite pattern and which are apparent after firing. These minute cracks or "tears" originate in the enamel coating after spraying or dipping and before fusion, and they fail to heal perfectly during firing. The torn area is usually a minimum width of several tearing marks. Tearing is differentiated from hairlining, which is ordinarily seen as one or more smooth and continuous pencil lines in the fired surface. Because no systematic investigation or explanation has been advanced concerning the action of sodium nitrite, this study was undertaken to determine the behavior of enamels to which this material has been added.

(1) Previous Use

Sodium nitrite has been used for some years as a mill addition (or as an addition after milling) to ground coats to prevent rust while drying and also as a setting-up agent. Its use in cover coats, however, has been

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Enamel Division). Received April 18, 1939.

recent. Although Bryant and Porter[1] used sodium nitrite as a mill addition in their fine-milled enamel and opacity work, no mention of its purpose was made.

(2) Purpose of Study

The introduction of a material such as sodium nitrite for a specific purpose, namely, the prevention of tearing, obviously presents the question of whether or not such a material would have a deleterious effect on some other property of the enamel. These studies therefore include (1) the amount of sodium nitrite necessary to control tearing with a given enamel milled to a certain fineness; (2) method of addition, *e.g.*, to the mill or to the enamel after milling; (3) limits of addition; (4) effect of aging; (5) rate of drying; (6) scumming tendency; (7) fusion hardness; (8) effect on reclaimed enamel; and (9) results of variation in specific gravity upon effectiveness.

II. Test Methods and Results

(1) Method of Making Tearing Test

Comparative tearing tests were made using test panels, $4^1/_2$ by 10 inches, enameled with a commercial ground coat at 36 grams per sq. ft. The panels were sprayed with the cover enamels at dry weights of 30, 40, 50, and 60 grams per sq. ft. in one coat. The sprayed plates were put in an electric box-type drier operating at 250°F; when dry, they were removed and cooled to room temperature. The panels thus prepared were placed in a cross-bending machine, and a series was made deflecting 0.20, 0.30, 0.40, and 0.50 inch within a 9-inch span. The plates were held in the deflected position for 15 seconds, removed, and fired at the required temperature and time.

A Danielson-Lindemann cross-bending machine was used for this work, but it was modified to the extent of fitting the movable center member with a wooden block of which the top surface was curved to the shape of a piece of steel bent 0.60 inch. This insured a uniform curvature during deflection over as much area as possible.

Different degrees of tearing may be produced in cover enamels by cross bending in this manner, and tearing produced in this way simulates tearing on ware that is subject to warpage and working in the furnace before the enamel fuses.

(2) Mill Additions vs. Solution

Because it might be desirable to add sodium nitrite solution to the milled enamel just before using instead of as a mill addition, the relative effectiveness under both conditions was studied. Two mills, identical except that one contained 1% sodium nitrite and the other none, were run to the same fineness. After aging for one day, 1% sodium nitrite in solution was added to the enamel milled without sodium nitrite and a tearing test was made with each enamel.

No difference could be seen in the effectiveness of either method, and because it would be an advantage to add varying amounts of sodium nitrite in solution to portions of enamel from the same mill, this procedure was followed in subsequent tests.

A 50% solution was used because 1 cc. of solution contains $^1/_2$ gram of sodium nitrite.

(3) Control of Tearing

The question of how much sodium nitrite is necessary to prevent tearing in a given enamel was studied with a cover enamel containing different amounts of sodium nitrite. Concentrations of 0, $^1/_4$, $^1/_2$, and 1% of sodium nitrite were used, and the procedure for making tearing tests, described in section (1), was followed with each enamel (see results shown in Fig. 1).

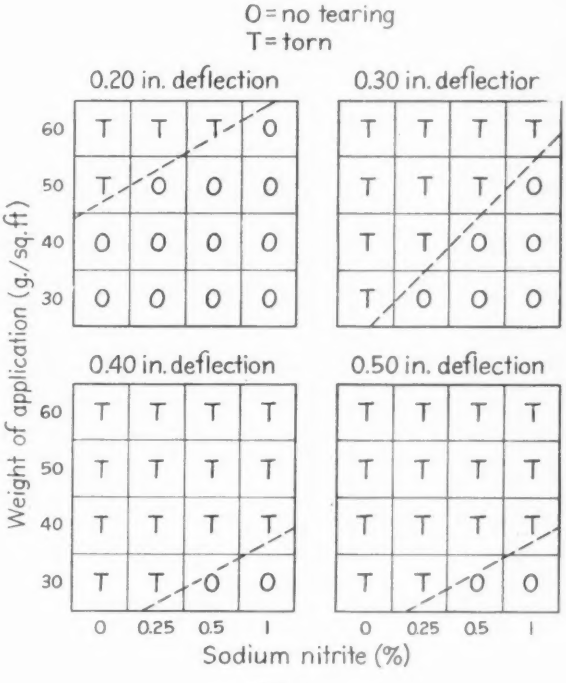

FIG. 1.

As the amount of deflection (or warping) or the weight of application increases, the amount of sodium nitrite necessary to eliminate tearing also increases. Although no attempt was made to classify the degree of tearing, sodium nitrite progressively reduced the severity of the defect but did not eliminate it in the higher weights and greater deflections.

These tests were checked with enamels from each of the several frit classifications, including opaque white, superopaque, acid-resisting, and stainless. All of the nonacid-resisting enamels duplicated the results given. In the acid-resisting and stainless class, the effectiveness of sodium nitrite was reduced about 25 to 40%, as determined by a visual examination of the severity of tearing.

Because of the increasing use of finely milled enamels, duplicate tests were made with enamel milled to about 1% on 325-mesh. The results were substantially the

[1] G. L. Bryant and F. R. Porter, "Effect of Mill Practice and Mill Additions on the Opacity of Enamels," *Jour. Amer. Ceram. Soc.*, **19** [2] 55 (1936).

same as with ordinary milled enamel (5 to 7% on 200-mesh).

It is important to know how far the addition of sodium nitrite may be carried to overcome tearing. At $1^1/_4$% of sodium nitrite, a slight lack of gloss and fuzzy texture began to show, and at $1^1/_2$%, the enamel began to blister.

(4) Aging

A study was also made on the effect of aging upon enamel with sodium nitrite milled in and the effect of adding sodium nitrite in solution to aged enamel. Two mills of enamel were run, identical except that $^1/_2$% of sodium nitrite was added as a mill addition to one enamel. After aging for one day, a portion of the enamel milled without sodium nitrite was taken, and $^1/_2$% of sodium nitrite in solution was added to it. A tearing spread and viscosity test was made with each enamel. This procedure was repeated at the end of 5, 9, and 15 days' aging.

No difference could be seen in effectiveness in stopping tearing as a result of aging on either enamel with sodium nitrite milled in or added before each test. The viscosity measurement, however, of the enamel to which sodium nitrite had been added before use was higher in each case than that of the enamel with sodium nitrite milled in.

(5) Rate of Drying

Because enamels containing sodium nitrite did not dry on the sides of containers left open to the air as is common with ordinary enamels, the effect of sodium nitrite on the rate of drying in air was investigated.

Two panels of 2 sq. ft. each were sprayed at a dry weight of 45 grams per sq. ft., one with enamel containing $^1/_2$% sodium nitrite and the other with enamel containing no sodium nitrite. The panels were allowed to air dry on a balance, and the time was recorded for each 2-gram loss of weight until no further loss occurred. Although the sodium nitrite enamel seemed to lose weight faster at first, both were completely dry in the same length of time.

(6) Scumming Test

The addition of even a small amount of a soluble salt may often cause scumming either upon firing or after washing with water. The ends of fired panels of enamel with no sodium nitrite and with 1% of sodium nitrite, therefore, were immersed to a depth of 1 inch in tap water at 100°F for 48 hours. No sign of scum was found on either set of panels.

(7) Fusion Hardness

Because sodium nitrite melts much below enameling temperatures, its effect on the softening point of an enamel was checked. One half of a ground-coated plate, 9 by 10 inches, was sprayed at 40 grams per sq. ft. dry with an enamel which contained 1% of sodium nitrite. After this enamel had dried, the other half was sprayed at the same weight with enamel containing no sodium nitrite, using a mask to cover the enamel already dried. This second application was dried, and the plate was fired to the point at which fusion begins. After cooling, the relative glossy area on each half was compared and was taken as an index to the relative softening points. There was no apparent difference in the softening points of the enamels shown by this test.

(8) Effect on Reclaimed Enamel

The effect of sodium nitrite on reclaimed enamel after aging was studied to determine whether the sodium nitrite had any deleterious effect on the enamel and if it would retain its effectiveness over the normal aging period. Accordingly, reclaimed enamels containing no sodium nitrite and some of the same enamel containing 1% sodium nitrite and reclaimed were aged for seven days. They were blunged with water, and tearing test panels were sprayed at 40 grams per sq. ft., dried, deflected 0.40 inch, and fired. The sodium nitrite enamel showed no tearing marks and no sign of any harmful effects from aging. The straight enamel tore to the same degree as was usually apparent under this test.

(9) Specific Gravity

Because the specific gravity of the same enamel may vary from one plant to another, depending upon shop practice, the effect of this variable on the ability of sodium nitrite to stop tearing was determined. The specific gravity of a cover enamel was varied from 1.65 to 1.85 (grams per cc.) and 0 to 1% sodium nitrite was added. Tearing tests were made, and no apparent difference in the effectiveness of the sodium nitrite could be seen.

III. Summary

The effects and use of sodium nitrite in cover enamels may be summarized as follows: (1) it may be added with equal effectiveness either as a mill addition or as a solution just before setting up for use; (2) the amount necessary to control tearing will depend upon individual plant practices and conditions; amounts of $^1/_8$ to $^1/_2$% will correct the usual tearing that may be found on one-coat work; (3) it is equally as effective in finely milled enamels as in coarse-milled enamels; (4) 1% is the maximum amount that may be safely added to an enamel; (5) it has little effect on the rate of drying of sprayed ware; (6) it will not aggravate scumming under the conditions tested; (7) it will not affect maturing temperature of an enamel; (8) it has no harmful effect on reclaimed enamel; (9) it retains its effectiveness over the normal range of specific gravities.

IV. Discussion

To the question, why sodium nitrite stops tearing, the writer has been unable to prove conclusively any single reason for its action.

Some manufacturers make a practice of dust-spraying after drying with a resultant decrease in tearing. With this in mind, a test panel was sprayed at 40 grams per sq. ft. with enamel that contained no sodium

nitrite; there was a deflection of 0.40 inch after it was dry. Before firing, the panel was subjected to a water spray sufficient to moisten the dry enamel. This panel showed considerably less tearing after firing than a panel run under the same conditions but without the water spray. The action here possibly lies in renewing the bond that has been fractured by deflection.

Sodium nitrite melts at 271°C or 520°F and has a wetting and plasticizing effect on clay. This was determined by heating a mixture of powdered clay and sodium nitrite crystals in a small furnace and observing a ready wetting action on the clay by the molten sodium nitrite. This mix could be worked readily to a plastic mass. It is possible that as the sprayed enamel heats in the furnace, the sodium nitrite exercises this wetting and plasticizing effect on the clay as it melts, thereby remaking the bond before the enamel fuses. It is also possible that the sodium nitrite addition results in a tougher or more elastic enamel bisque which can resist rupture from warping metal as the system heats.

In a series of tests, enamels were milled in alcohol to prevent the solution of the soluble materials, and cross sections of tearing on panels were made. The sodium nitrite, to be effective, must be in solution in the enamel when the ware is sprayed.

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A NEW PUMPING DEVICE*

By E. B. George

Abstract

The evolution of the art of pumping is discussed, and a comparison is made of the fundamental principles used in domestic and industrial pumping. The problems of liquid translation and a discussion of the point where the use of pumps leaves off and that of conveyers begins are also presented.

I. Introduction

In all probability water was one of the first problems of man. It was, first of all, indispensable to his existence. As the raising of water was one of his first engineering tasks, so the handling of liquids remains such to the present time. This problem has followed the program of civilization with ever-increasing complication and importance.

To reach water at moderate depths, the most simple contrivance was the use of the inclined plane which permitted not only the raising of water to higher levels but also allowed both man and beast to reach the water. The fountain of Siloam in Palestine was reached by a descent of thirty steps, and water was drawn in vessels made from shank bones of camels. The first mechanical device used to raise water was a flexible cord or rope. Vessels were first lowered by means of ropes. This means of lifting water, which has been used by all nations, was a common method of hoisting water during early Bible history. Many variations of the vessels and rope were found to exist in the days of the Pharaohs, notably the pulley and single vessel and the windlass with two vessels counterbalanced over a drum.

These devices have counterparts in the Chinese windlass, the Persian wheel, the Picotah of Hindustan, the Roman screw, and the tympanum of India. Capstans, multiplying pulleys, and levers were also used to hoist water during the building of the pyramids in Egypt. Such devices were known to have been used in Joseph's well, which may be seen at Cairo, Egypt, to this day as a marvel of engineering skill In his historical introduction to hydraulics, Nehemiah Hawkins records the invention of the "force pump" by Ctesibius 200 B.C. The "double-acting" pump was devised by La Hire in 1718, and the history of the piston-type pump is closely identified with that of the steam engine upon which it was so dependent.

Similarly, the centrifugal pump is closely related to the development of the waterwheel. It has its original form in the rope pump in which one or more endless ropes were passed over two pulleys. These pulleys were grooved in their surfaces and, by rapid rotation of the upper pulley, the water absorbed by the rope was both squeezed and slung out of the rope by centrifugal force. The date of this invention is not definitely known, but the device is believed to belong to the latter part of the 16th century.

The centrifugal pump can not be definitely traced in its development, but Dennis Papin, a French engineer, is known to have designed and built a device which was termed "the Hessian suck" in 1703. It had a volute casing and double port inlets with an open-type impeller. The description of its original form closely resembles its present construction.

The turbine pump was evolved from the turbine wheel. It had its earliest form in Barker's reaction wheel invented about 1740. A number of variations in design by Fourneyron and other engineers followed, which made use of the radial and horizontal flow of water and of one and two "runners" with interposed stationary vanes. In 1876, 87% efficiency of conversion of water energy was obtained. By inverting the principle of the turbine water wheel, the turbine pump was developed.

Rotary pumps were developed during the latter part

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 30, 1938 (Materials and Equipment Division). Received March 30, 1938.

of the 18th century and are designed in more variations of form than any other type of pump. In this classification fall the gear, the eccentric vane, the cam and roller, and the screw pumps, as well as many other special designs.

II. The Moineau Principle of Pumping

René Moineau was a French pilot in the World War and at the present time is a member of the Officers' Reserve Corps and an engineer of the French Aviation Corps. Moineau, who believed that a positive displacement supercharger could be devised using the principle of meshing helical stationary and rotating members, designed, patented, and constructed the first "Moyno pump" about six years ago.

In working principle, the Moyno pump, upon first analysis, is an apparent paradox, inasmuch as the working elements consist of a single-thread, double-pitched helix or thread meshing with, and turning in, a double-threaded, single-pitch stationary member. This describes the pump in simple form, but it may be made in all combinations of one tooth or helix, more in the stator than in the rotor.

The action of these working members in simple form is such that a single-pitch length of the stator provides a definite seal between the two ends. Because the stator has two open helices when viewed from the end and one of these is occupied by the rotor, the other will present an opening for the inflow of the liquid. The relation of the cross section of the rotor to that of the stator is such that it rolls in every position with an oscillating motion from one helix to the other. In so doing, a complete revolution of the rotor effects a positive displacement of the open helix with an endwise translation of the contents.

III. Characteristics of Operation

The Moyno pump is not a screw pump, it is not a centrifugal pump, and it is not a reciprocating pump, but it combines several of the characteristics of all of these. It is valveless, has uniform flow, is self-priming, and is positive in displacement.

Unusual suction characteristics result from the close adherence of the stator member to the rotor when one member is made of rubber or plastics. The helical seal line of a stator pitch effectively seals between the two ends of the pumping elements; as the rotor rolls from side to side, the displaced helix opens up, a vacuum is created, and liquid fills the open helix. As the rotor displaces the helix filled with liquids, the seal line cuts off a volume or slug of liquid within the pitch length. Further rotation continues to displace the contents endwise, the alternate helix fills in the meantime, and the flow is thus made continuous.

Because the cross-section area of the stator is constant and the displacing section of the rotor is constant, the flow section is also constant, and because the rotation is uniform, the total displacement is of uniform pressure and nonpulsating. The inclosed slug of liquid is literally squeezed or "squeegeed" ahead of the advancing screw, and this action has been aptly termed that of a "liquid jackscrew."

The foregoing explanation has been based upon a close-fitting stator, such as rubber. Tests have shown that the liquid seal of a wet rotor, when both members are made of metal, is equally effective in pulling a vacuum. Commercial tests, using a U-tube mercury gauge, almost invariably produce a vacuum of 28 inches and occasionally as high as 29 inches, depending upon the barometric pressure.

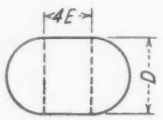

Fig. 1

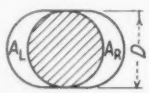

Fig. 2

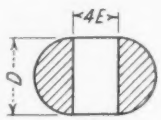

Fig. 3

The cross section of the stator may be illustrated as two semicircles joined by two straight lines (Fig. 1).

$$\frac{\pi D^2}{4} + 4ED = \text{area of stator.}$$

Where E = eccentricity of rotor orbit.
D = rotor diameter and stator inside diameter.

To determine the cross-section area available for liquid flow, the rotor area is deducted from the preceding equation.

$$4ED + \frac{\pi D^2}{4} - \frac{\pi D^2}{4} = 4ED.$$

This area for the flow of liquids at various transverse sections may be of two parts, A_l and A_r, but their sum is always constant and equal to $4ED$. If these sectional areas are integrated for a full stator pitch length, the resultant volume is the volume per revolution or

$$V = 4EDP_s.$$

If N = rev./sec.

$$Q = 4EDP_sN \times 60.$$

Where Q = vol./minute of theoretical displacement (expressed in cu. in., cu. ft., or gal./min.)

Regardless of how closely the rotor may be fit to the stator, there will always be some leakage. The net volume of displaced liquid is the difference between the theoretical volume as follows:

$$Q = 4EDP_s.$$

Q_l = leakage vol.

$$\text{Then } Q_t = 4EDL_s - Q_l.$$

An empirical equation has been established for Q_l by observing the actual leakage in full molded rubber stators and calculating the equivalent radial clearance depth along the leakage path, under the condition of a given head pressure and suction lift, whereby

$$Q_l = (0.001 + 0.0000001374EDP_s) \times \sqrt{\pi^2H(4E + D)^2 + P_s^2} = \text{U. S. gal. leakage/min.}$$

$$\text{Then } Q_t = 0.0000001374EDP_sN - (0.001 + 0.0000001374EDP_s)\sqrt{\pi^2H(4E + D)^2 + P_s^2}.$$

Q_t = net delivery in U. S. gal./min.

The symbols are used in mixed metric and English units to coördinate French, English, and American designs.

E = eccentricity of rotor orbit in relation to geometric central axis of stator (mm.).
D = diam. of rotor (mm.).
D = circle diam. of stator if no clearance is allowed for rotor.
P_s = pitch of stator helix (mm.).
H = total lift (ft.).

The foregoing capacity formula applies to water or liquids of equal viscosity. The coefficient of leakage obviously will vary for any change either in viscosity of the liquid or in the resilience of the stator. Investigation is contemplated to determine the effect of both viscosities and resilience on the volumetric efficiencies of these pumps. Moyno pumps are known to be efficient in handling viscous liquids, but accurate coefficients for precalculation have not yet been determined.

The equation of maximum velocity per second of any particle of flow may be shown to be

$$V = N\sqrt{\pi^2 (4E + D)^2 + P_s^2}. \quad (1)$$

Where V = velocity (ft./sec.).
N = revolution/sec.

With an equation for theoretical displacement and by neglecting the leakage element of that equation, the behavior of the variables that constitute the fundamentals of design of the pump may be investigated mathematically.

$$Q = 4EDP_s \times N \times 60. \quad (2)$$

Knowing that the pump must be designed at approximate fixed motor speeds, *e.g.*, 1750 r.p.m. or 1150 r.p.m., $N \times 60$ becomes a constant, which, for purposes of examination, may be dropped from equation (2) as follows:

$$Q = 4EDP_s \text{ (quantity pumped/revolution)}. \quad (3)$$

This is an expression for the three fundamental variables of the pump. If the value of E is fixed, and a maximum velocity is assigned to V in equation (1), assumptions are made that permit differentiation by partials for D and P_s, the variables which fix the volumetric dimensions of the pump.

$$\frac{\delta Q}{\delta D} + \frac{\lambda \delta V}{\delta D} = 0. \quad (4)$$

$$\frac{\delta Q}{\delta P_s} + \frac{\lambda \delta V}{\delta P_s} = 0. \quad (5)$$

In which λ = an auxiliary constant (later to be eliminated).

Differentiating the respective values for Q and V given by equations (1) and (3),

$$4EP + \frac{\lambda \pi^2 (4E + D)}{\sqrt{\pi^2 (4E + D)^2 + P_s^2}} = 0. \quad (6)$$

$$4ED + \frac{\lambda P_s}{\sqrt{\pi^2 (4E + D)^2 + P_s^2}} = 0. \quad (7)$$

Equation (7) constitutes a relationship for the variables to give either maximum or minimum values. Solving equations (6) and (7) for λ, and subtracting,

$$P_s^2 = \pi^2 (4E + D)D. \quad (8)$$

Eliminating P_s between equations (1) and (8),

$$\frac{V}{N} = \sqrt{\pi^2 (4E + D)^2 + \pi^2 (4E + D)\, D.}$$

$$= \pi\sqrt{2} \cdot \sqrt{8E^2 + 6ED + D^2.}$$

From which $D = -3E \pm \sqrt{\frac{1}{2\pi^2}\left(\frac{V}{N}\right)^2 + E^2}$. (9)

By substitution in equations (8) and (9), critical or ideal values of D and P_s are determined to deliver a maximum output for fixed values of velocity of flow within the pump and at a given speed. By computing the maxima for several values of E, a graph may be plotted showing the ideal values of E, D, and P_s to give maximum pumping capacities per revolution at fixed values of speed and chosen velocities of flow.

By computing the ideal ratios of E, D, and P_s with fixed flow velocities but at various speeds, increasing capacities are obtained so a complete graph of the ideal values of E, D, and P_s may be plotted, covering a range of capacity requirements from zero to the maximum desired output for the largest size of pump to be built. Then in the event of a new requirement or capacity, it is possible merely to refer to that graph and to take off the values for each of these fundamental variables of design.

IV. Resultant Characteristics of Operation

Having discussed the principle of operations and the fundamentals of design and their relationship in the formula for capacity, the resultant characteristics of the pump may be reviewed.

A single pitch length of the stator has been shown to effect a complete seal with a stationary rotor against the backward flow from the high-pressure side to the low-pressure side, although the pump has no valves. It has also been shown how to design the pump with any chosen velocity of flow through its working parts. For economy of material, a maximum velocity of 27 feet per second may be chosen; 5 feet per second might have been used just as readily, in which event the flow velocity would not exceed that of the connecting pipes. Flow velocity is important when pumping abrasive liquids. The erosive wear is almost directly proportional to the velocity of flow within the normal range of usable pipe velocities.

The pump is positive in its displacement, and theoretically it has no pressure limit. With single-stage pumps delivering average pressures, the leakage percentage throughout its useful range is 12 to 15% or less, and it can be shown that the leakage varies approximately inversely as the number of stages. This emphasizes the desirability of using two or more stages whenever it is required that the pump serve for metering purposes or to secure high pressures. In stepping up pressures by the use of multistages, the reduction of the leakage factor would indicate that the obtainable pressures should vary in proportion to the square of the number of stages; but to rate the effect of adding stages conservatively, an exponent of about 1.5 is recommended.

P_2 = $P_1 \times n^{1.1}$.
P_2 = permissible multistage pressure.
P_1 = permissible single-stage pressure.
n = number of stages.

Because of the helical flow of the liquid in the stator, a component of flow always exists in the line of action, whereas many other types of pumps derive their line of flow from the hydrostatic pressure built up against the casing or housing within which the liquid is confined. The effectiveness of power application to the "jack-screw" flow of the Moyno pump may be best appreciated in instances in which the solid content of the liquid ranges up to 65%, such as clay slurries for cement mills. There are on record tests of a well-known centrifugal pump handling 110 gallons per minute of this material, requiring an input of 32 h.p. A Moyno pump was installed which delivered 128 gallons per minute; it was driven by a 10 h.p., 869 r.p.m. motor (loaded only to 8.3 h.p.).

The erosion of flow of these liquids containing solids wears out the working parts of any pump, and the problem of replacing worn parts therefore must ever be given consideration. The rotating assembly of a Moyno pump consists of the rotor and drive shaft, which passes through the packing gland. Inside these two members is a connecting rod or drive link, the ends of which are rather securely protected from abrasion. The only stationary member that works with these parts is the stator, which in effect is a casing liner. Replacement of these two parts renders a new pump; usually it is necessary to replace only the stator and much less frequently the rotor.

V. Problems of Liquid Translation

Liquid translation means that liquid is picked up at one location and delivered to another. In "translation" of water, this problem is so common that its behavior is quite well known, but there are surprises in the attempt to handle hot waters in temperature ranges of 180° to 212°F or above. Because Moyno pumps have unusual suction, the lifts must be rather heavily loaded with suction pressure head to avoid "flashing" over into vapor. This tendency may also be controlled by running the pump at a reduced speed.

Homogeneous liquids may be divided into two classes, *viz.*, lubricating and nonlubricating types. The lubricating liquids present no great hardship in pumping other than that of their viscosity. Viscosity is a problem within itself, solved only by large openings and slow speed. Many different types of pumps may be used to handle lubricating liquids as the lack of lubrication in liquids constitutes the main source of wear and tear on the mechanism. Industry is continually on the lookout for a pump that will handle nonlubricating liquids without a high rate of mortality. Several types of pumps fail utterly unless there is sufficient lubricant for the closely fitted rubbing parts. Any liquid that wets the internal surfaces constitutes a lubricant. Although lubrication is a factor in the operation of Moyno pumps, it is less important than in those types of pumps which involve closely fitted end housings, close impeller clearances, reciprocating parts, parts involving valves, cams and rollers, gears mounted on pins, and similar mechanical constructions.

The Moyno pump has no closely fitted clearances in the usual sense of machined tolerances, except the ball-bearing fit in the bearing housing. The end adjustment is not a factor because the rotor is not required to align closer than $^1/_4$ inch between the stationary and the rotating parts. All injurious wear is of a diametrical nature, *i.e.*, either the stator wears the opening oversize or the rotor wears undersize. There are no internal bearings to wear out, no valves to replace, and no cams, rollers, or gears.

The handling of solids in suspension is the eternal problem of pump manufacturers and industry alike. These solids may be divided into two general classes, *viz.*, those that are granular or crystalline in structure and those that are heterogeneous or fibrous by nature. Both may be abrasive or essentially nonabrasive. Most of the abrasives fall in the granular class. To handle abrasives with metals, the problem becomes that of constructing the working parts of materials as much harder than the materials handled as conditions will permit and then to determine the type of pump which will be the least subject to the destructive action of friction and erosion, bearing in mind the cost of replacement and maintenance. On the other hand, the successful handling of pulps and fibrous materials becomes one of clearances in the moving parts or openings for passage into and through the pump.

The percentage of liquid in the mixture is a deciding factor of pumping in both cases but much more so in instances of pulps and fibrous materials. This is evident in the difficulties in handling paper pulps of 7 to 8% compared to 3 or 5% pulp content.

The problem of handling pulps and fibrous solids combines the requirements of large passages through the pump with low velocities and abrasive resistance, although the latter is less important than the handling of granular or crystalline solids.

The Moyno pumping principle probably offers the best means of handling solids in suspension of any such principle. Whenever possible some form of rubber should be used to secure the greatest wear resistance to abrasives.

In its present design, the Moyno pump will handle solids up to 65% of the content of materials, such as drilling muds, mine slurries, clay slips, and similar mixtures of granular structure and 5 to 8% fibrous pulps. If expressly designed for these various specific applications, improvements in durability may no doubt be made. No experiments have been made on the enlargement of diameters and shortening the pitch of the stator, both of which should greatly facilitate handling solids in liquids.

VI. Where Pumps Leave Off and Conveyers Begin

It is the designer's judgment that the benefits of such an investigation should be devoted to extending the life and durability of the pump rather than to continue to reduce the liquid content. Further concentration of solids should be left for conveyers to handle rather than

pumps. The possibility of additional reduction may exist, however, because only 2% of the volumetric capacity is necessary to operate the Moyno pump as a vacuum pump or as an air compressor.

Bibliography

Nehemiah Hawkins, Pumps and Hydraulics. Theodore Audel & Co., 1905 (out of print).

Frank A. Kristal, "Pumps and Pumping," *Chem. Eng.*, **44** [5] 250–57 (1937).

El Mathy, *Western Machinery & Steel World* (January, February, and March, 1937).

Arthur M. Green, Pumping Machinery, 2nd ed. revised. John Wiley & Sons, New York, 1919.

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USE AND ECONOMY OF A ROTARY DRIER IN MANUFACTURE OF BRICK AND TILE*

By J. W. Whittemore

Abstract

The use of a rotary drier at the Roanoke-Webster Brick Company is discussed. The capacity of this plant has been greatly increased by drying the tailings from the screens and thereby increasing the capacity of the grinding equipment.

I. Introduction

The deposit of the Roanoke-Webster Brick Company of Roanoke, Virginia, contains several strata of material. Some of these are extremely hard shale, and others are unconsolidated, damp material not unlike many alluvial clays. During a long wet period of weather, these softer, more claylike strata become quite damp and subsequently cause considerable trouble in grinding and screening.

The practice, in the past, has been to add dried brick to the grinding pan to help the damp material through the pan. Without these additions of dried material, it was impossible to grind sufficient material to manufacture forty thousand brick per day. Many times during wet periods the grinding pan was kept in operation for twenty hours to insure ground material sufficient to manufacture the forty thousand brick on the succeeding day. Because of these difficulties, it was decided to install a rotary drier so that dried material could be fed to the grinding pan.

II. Changed Operation

The raw materials were won by steam shovel, hauled to the plant, and dumped over a grizzly into a comparatively large bin. The material was fed into a Maximuller grinding pan by an apron feeder whose starting switch was controlled by the electrical load on the grinding pan. Material passing through the grinder was carried by a bucket elevator and scraper conveyer to six vibrating screens. Large openings in the grinding pan were possible with this number of screens and a large circulating load could be maintained, with subsequent increased capacity of ground material from the grinder. The tailings from the screens were returned to the pan for further grinding with this arrangement, which is similar to the plants using shale and manufacturing structural brick.

A rotary drier was installed to increase the capacity of the plant during wet seasons from forty to sixty thousand brick (a capacity which could be maintained in dry weather) and perhaps to increase the dry-weather capacity. The particular drier chosen was 42 inches in diameter and 36 feet long. The hot gases of combustion from the stoker-fed furnace pass through a stationary mandrel in the center of the shell and are baffled back through the space between the mandrel and the outside shell. These gases of combustion are removed by an induced draft. The fan throws the gases of combustion, and any dust that is picked up, into a chamber where the velocity is decreased sufficiently to drop all of the dust.

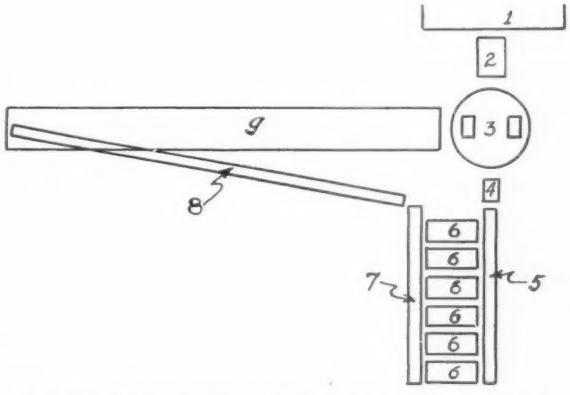

Fig. 1.—Diagram of flow of materials in preparation for forming: (1) grizzly and bin; (2) plate conveyer feeding grinder; (3) grinding pan; (4) bucket elevator; (5) scraper conveyer feeding screens; (6) vibrating screens; (7) belt conveyer for tailings; (8) belt conveyer carrying tailings to drier; (9) rotary drier.

The clay enters the drier from the same end as the furnace, but passes through the drier in the space between the mandrel and the outer shell so that it is moving contrawise to the direction of travel of the gases of combustion.

Figure 1 shows the arrangement of the equipment after the installation of the drier. It may be noted that the tailings from the screens are fed to the rotary drier and then pass to the grinding pan. Soon after

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Structural Clay Products Division). Received April 19, 1939.

the installation of the rotary drier, the grate openings in the bottom of the grinding pan were enlarged so that an increased amount of tailings was fed to the rotary drier, which in turn fed a larger amount of dry material to the grinding pan; this in turn assisted the pan to increase the amount fed to the screens. The net result of the installation has been that sufficient material is ground and screened in nine hours in wet seasons for the manufacture of seventy-five thousand brick. This is a 25% increase of capacity over the capacity of the plant in dry weather before the installation of the rotary drier.

III. Efficiency and Work Accomplished by Drier

To determine the work done by the rotary drier, the weight of material passing through the pan, the rotary drier, and the auger extrusion machine was determined. The moisture content of these materials was also obtained. These readings are typical for wet seasons as they were taken after two months of extremely rainy weather. These figures are shown in Table I.

TABLE I

Operation	Dry clay/hr. (lb.)	Moisture content (%)	Total moisture content/hr. (lb.)	Temp. (°F)
(1) Material fed to grizzly	50,000	24	12,000	58
(2) Material passing screens	50,000	19	9,500	76
(3) Tailings fed to rotary drier	16,000	17	2,720	72
(4) Tailings fed to grinding pan by rotary drier	16,000	5	800	125
Air leaving drier				132
Atmosphere				62

It might appear that the difference between (1) and (2) of Table I, which is 2500 lb. of moisture per hour, should be nearly the same as the difference between (3) and (4), which is 1920 lb. The probable explanation for this difference is that the material coming from the rotary drier is at a temperature of 125°F, which is sufficient to raise the temperature of the material in the grinding pan and of the screened material, with subsequent evaporation from the material after screening.

From Table I and the following data, the work done and the thermal efficiency may be calculated.

(1) Weight of moisture removed by rotary drier per hour, 1920 lb.
(2) Average atmospheric conditions in 62°F, 60% relative humidity.
(3) Air conditions leaving drier, 132°F, 95% relative humidity.
(4) Coal used, 275 lb. per hr.; 14,000 B.t.u. per lb.

Lb. moisture per lb. dry	air leaving drier	= 0.109
	atmospheric air	= 0.007
Lb. dry air required per hr.		= 18,824
Heat supplied drier per hr. (B.t.u.)		= 3,850,000
Heat required for	evaporation (B.t.u.)	= 2,104,320
	air (B.t.u.)	= 316,240
	dry clay (B.t.u.)	= 195,040
	moisture in clay leaving drier	= 80,000
Total		2,695,600
Heat lost by radiation, ash, unburned coal, etc.		= 1,154,400 B.t.u.
Thermal efficiency of drier		= 70%

The approximate cost of the equipment and installation of this drier was slightly less than $10,000. The operating cost consists of coal consumed and electric power for the stoker and exhaust fan, and little labor, inasmuch as a man in charge of the operation of other equipment can visit the drier often enough to insure efficient operation without any appreciable disturbance to his usual activities.

With the comparatively low initial cost, low operating cost, and high thermal efficiency of this drier, this company has been more than repaid for the installation of the drier.

The continued operation of the plant at capacity with the subsequent decrease in cost of unit of production, when otherwise it would have been operating at half production or less, has justified the installation of the drier.

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MECHANICAL STOKERIZATION OF REFRACTORY FIRING KILNS*

By H. M. Christman

Abstract

A description is given of the mechanical stokers used, the problems encountered in their application to rectangular and round kilns, and the changes made in the original equipment. An analysis of the coal suited for stoker firing, a summation of fuel savings, and the advantages and disadvantages of stoker firing, based on experience with stokers in regular production over a period of years, are also presented.

I. Introduction

The equipment for mechanical stokerization consists of a hopper from which coal is conveyed into a cast-iron retort by a screw conveyer. An electric motor rotates the screw, and the feed is varied by a pawl and rachet mechanism. A safety pin is provided which shears in case of clogging. A fan forces air into a sealed pit covered by cast-iron dead plates which form the floor of the combustion chamber, the amount of air being regulated by a damper. The air keeps the metal plates cool and enters the combustion chamber through heat-resisting, perforated tuyère blocks which rest upon the top of the retort (Fig. 1). As the incoming coal approaches the tuyère zone it is partially coked, and combustion takes place as it travels through the tuyère zone. The action of the incoming coal keeps the fuel bed constantly agitated. By the time the coal is completely burned, it has traveled to the side of the combustion chamber from which the ashes are periodically removed.

The initial equipment was installed in a small rectangular kiln which was filled only with raw material to be calcined. A stoker with a capacity of 100 pounds of coal per hour was placed in each end, and the kiln was fired satisfactorily to cone 16 down. The kiln was reset with straight brick and the results again were satisfactory. In the next thirty cycles, commercial ware of every description was satisfactorily fired, ranging from cones 8 to 16.

The fuel reduction was 11.8% during this period. The cost of the slack coal was approximately 68% of that of the lump coal regularly used in hand firing, which gave a total fuel savings of 39.6%.

II. Installation in Circular Kilns

A stoker with a capacity of 300 lb. of coal per hour was installed in each of the two ware-charging doors of a round kiln 28 feet in diameter. The ten fire holes were bricked up. In this initial installation, only about half the amount of coal was required for firing to 2000°F as compared with hand firing. After holding the stokers at a maximum capacity for 48 hours, however, a temperature of only 2100°F was reached. The stokers therefore were removed from the kiln doors, the fire boxes were opened, and the kiln was finished by hand firing. Excellent results were obtained with stokers with a capacity of 500 lb. of coal per hour, similarly installed except for some difficulty in cleaning fires because the door openings were too small.

The kiln usually cleared up or first showed red at the center in hand firing, and this red zone gradually worked to the exterior. This order was reversed with stoker firing which raised the question of firing a round kiln with only one stoker. A stoker with a capacity of 1000 lb. per hour was installed in the side of the kiln, setting at right angles to a line between the two ware-charging doors. A rectangular bag wall was built around the stoker. From the standpoint of heat distribution, several satisfactory firings were made, but fly-ash was deposited on the upper courses of brick. The fuel consumption was reduced 12.6%, which with the reduced cost of coal netted a 40.1% savings in fuel.

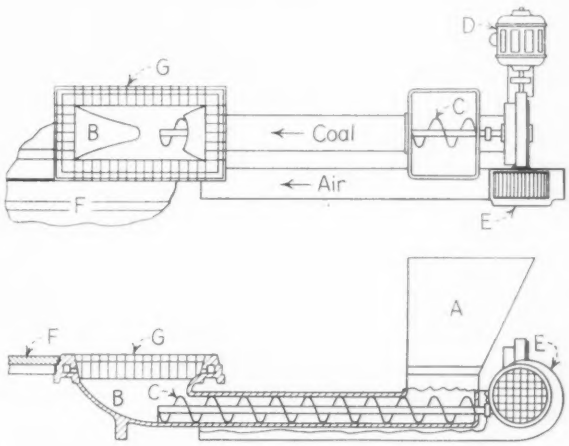

Fig. 1.—(*A*) coal hopper; (*B*) retort; (*C*) screw; (*D*) motor; (*E*) fan; (*F*) dead plates; (*G*) tuyères.

In an attempt to eliminate fly-ash trouble, the stoker was set in a Dutch oven between two round kilns. While one kiln was being fired, a $13^1/_2$-inch wall closed off the opening into the second kiln (Fig. 2). The fuel consumption with this arrangement was increased about 2%.

III. Changes in Original Equipment

Changes which have been found advisable in the original equipment are as follows: (1) the mechanical mechanism has been moved about 8 feet back from the coal hopper by inserting a pipe, thus providing more room for cleaning, etc.; and (2) the air duct is placed under ground, which also facilitates cleaning.

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Refractories Division). Received April 18, 1939.

IV. Fuel

It is not true that *any* type of low-grade fuel may be used. The coal must possess a high fusion-point ash to prevent trouble at high temperatures. According to various tests, temperatures of 2800° to 2900°F appear to exist in the Dutch oven while finishing a kiln 28-foot in diameter. West Virginia gas-producer coal, minus $1^1/_8$ inches plus $^3/_8$ inch in size, has been found suitable for this equipment. An approximate analysis is as follows: moisture 2.70%, volatile 35.80%, carbon 52.70%, ash 8.80%, fusion-point ash 2520°F, and B.t.u. 13,950.

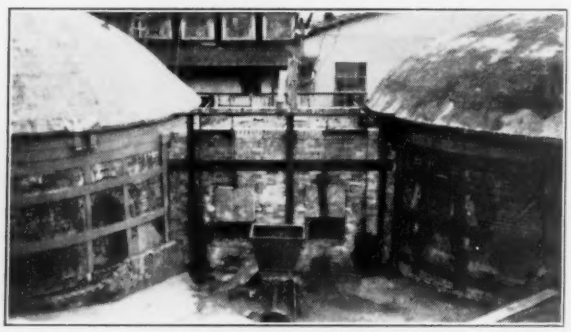

FIG. 2.

V. Heat Distribution

Heat distribution in a stoker-fired kiln has always been uniform and easy to control because of the marked difference between forced draft and induced draft in firing a kiln. With forced draft, if the setting is opened, more heat invariably will be provided in any location. It has been found advantageous, however, to place the stokers in a pit with the grates at the same level as the kiln floor.

VI. Advantages and Disadvantages of Stoker Firing

The use of stoker firing offers the following advantages: (1) There is approximately 12% fuel reduction. (2) There is usually a lower fuel cost per ton, although this depends upon the locality. The cost and maintenance of electric power must be deducted from this savings. (3) A shorter firing cycle is possible because the operation is always under complete control. The water-smoking period may be shortened because excess air can be circulated through the kiln to carry off moisture, which eliminates any tendency of the kiln to choke up.

(4) Smoke is eliminated. The air feed at high temperatures is reduced until smoke just appears and then is increased gradually until the smoke just disappears.

(5) There is a savings in labor. The use of stokers lightens the work of the fireman and permits him to assume additional duties. Slack coal or finer sizes may be dumped directly into the stoker hopper from the wheelbarrow (Fig. 3) or they may be handled mechanically.

(6) Better ware is obtained with less kiln loss, owing to the maintenance of oxidizing conditions throughout the firing cycle and to the elimination of kiln marking during the water-smoking period.

FIG. 3.

The disadvantages of stoker firing are as follows: (1) There is occasional mechanical breakage while the kiln is under fire. To offset this breakage it is advisable to carry a set of repair parts in stock. (2) Power interruptions occur at times. Purchased power is used, however, and the interruptions in service have become less frequent and of shorter duration than formerly. (3) The initial cost of the equipment is high.

VII. Conclusions

Mechanical combustion equipment may be applied to kiln firing with results comparable to its use in other types of furnace work. This equipment has proved to be well adapted for firing refractories. The application of mechanical stokers to intermittent kilns in the general refractories and heavy clay products industries, however, presents a rather difficult problem because of the initial high cost of equipment required in relation to the exceedingly small percentage of time they operate at maximum capacity.

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PRECAST TILE BEAM FLOOR*

By Henry Giese and C. T. Bridgman

Abstract

A floor system is described which was developed in the Structural Clay Products Institute, Region 1-W, in the Agricultural Engineering Section of the Agricultural Experiment Station at Ames, Iowa. This system consists essentially of precast beams, which serve as joists, filler blocks laid from beam to beam, and a covering of concrete. By using only one specially shaped block, floors may be constructed which vary widely in length of span and in load capacity from light residential construction to that suitable for warehouses.

I. Introduction

The floor system described represents a development resulting from a research project at Ames, Iowa. This project was organized to study the farm utilization of clay products and to improve the services being rendered. Early in the study, attention was directed toward the development of a floor system which might be reasonable in cost and sufficiently flexible to meet the loadings imposed upon the various structures.

The Iowa Agricultural Experiment Station has long been active in promoting the use of masonry materials in order to use their high compressive strength to advantage and to supplement the use of steel to carry the tensile stresses, *e.g.*, in an Iowa silo, a masonry water supply tank, and an all-masonry barn. This Iowa research, in each case, has been directed toward placing the material at the lowest possible cost. By eliminating the unproductive labor required to make and remove forms and the unproductive material used in them, a floor may be constructed at a satisfactory cost that will meet the requirements placed on it.

II. Ideals for Floor Construction

A floor construction, to obtain wide usage in low-cost housing projects (farm houses and farm service buildings) should possess the following qualities: (1) The construction must be adaptable to a variety of design conditions without extensive engineering service, and the units of the floor must be so simple that the average builder will be able to lay out the floor plan. (2) The floor system must be sufficiently flexible to meet a variety of loading conditions without complicating the design data and with a minimum number of special units. (3) The floor itself should be simple in construction so that the average worker in the rural areas will be able to install it; special equipment to install the floor must be avoided; forms are expensive and should be avoided insofar as possible. (4) The materials should be easily manufactured and distributed, and the units should be of such size as to handle easily.

III. The T-Beam Floor

In the floor system described here, the load is carried largely by precast beams extending from wall to wall. The space between the beams is taken up by "span" or "filler" tile. The entire surface is covered with concrete after the beams and filler tile are in place. Tensile stresses in the beams are carried by the steel bars imbedded in concrete in "troughs" formed by recesses in the tile. The concrete topping, which is considerably thicker directly over the beam, and the span tile carry the compressive stresses.

Five factors affect the ability of the floor to carry superimposed loads, *viz.*, (1) length of span, (2) spacing of beams (length of span or filler tile), (3) cross-sectional area of steel reinforcing bars, (4) depth of span tile, and (5) thickness of concrete topping.

Thus, by using only one special shape of beam tile and perhaps two lengths to accommodate variations in span length, many load capacities are possible. It also meets the requirements for strength and simplicity. Because the beams are cast and later laid in place and the span tile are laid on ledges formed on the precast beam, no form work is required on short spans, and only one line of stiffening shoring is needed on long spans.

IV. Tests of Beams and Flooring

Two series of tests have been made. The first series was made on floor sections using the original beam block. Although these demonstrated the practicability of the floor, the data obtained indicated that changes should be made in the design of the block. The second series of tests was made on sections using the improved block which provided a deeper section and a larger compressive area in the top to assist in supporting the beam during construction; they were also scored to secure a better bond between the concrete and the tile. Test sections, in addition to the beam itself, comprised a $^1/_2$ length of filler tile on either side, which is typical of actual construction. The variations among the five factors are shown in Table I which describes the test sections.

Pigs of iron and lead were used to load the sections at third points. A steel plate, $^1/_4$ by 4 by 8 inches, firmly imbedded in plaster of Paris, provided a bearing surface over the supports, and a similar steel plate was placed over the tile supports. A steel roller, 2 inches in diameter, was placed between the two plates so that the sections would be freely supported. A similar arrangement was used to support the load at the third points. Deflections were read to 0.01 inch

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill. (Structural Clay Products Division). Received April 18, 1939.

TABLE I

TEST SECTIONS

Beam No.	Group	Floor tile: Span (ft.)	Length (in.)	Depth (in.)	Steel rods (2 in.)	Concrete topping (in.)	Live loads (lb./sq. ft.): Applied	Design factor 4	Deflection (in.): At design load	Allow 1/360 span	At failure
4	B	8	24	4	5/8	1.5	884	221.0	0.03	0.27	0.23
5	B	12	"	"	"	"	374	93.5	.06	.40	0.51
6	B	16	"	"	"	"	190	47.5	.10	.53	0.76
7	B	20	"	"	"	"	115	28.8	.16	.67	1.00
8	B	24	"	"	"	"	59	14.8	.25	.80	1.15
9	C	16	12	"	"	"	360	90.0	.12	.53	0.90
10	C	"	16	"	"	"	288	72.0	.11	.53	0.81
11	C	"	20	"	"	"	236	59.0	.11	.53	0.77
(6)	C	"	24	"	"	"	190	47.5	.10	.53	0.76
12	D	"	"	3	"	"	151	37.8	.14	.53	0.92
(6)	D	"	"	4	"	"	190	47.5	.10	.53	0.76
13	D	"	"	5	"	"	213	53.3	.09	.53	0.64
14	D	"	"	6	"	"	233	58.3	.07	.53	0.58
15	D	"	"	8	"	"	319	79.8	.06	.53	0.48
16	E	"	"	4	1/2	"	108	27.0	.05	.53	0.55
(6)	E	"	"	"	5/8	"	190	47.5	.10	.53	0.76
17	E	"	"	"	3/4	"	284	71.0	.16	.53	0.92
18	E	"	"	"	7/8	"	381	95.3	.18	.53	1.13
19	E	"	"	"	1	"	437	109.3	.16	.53	1.02
20	F	"	"	"	5/8	0.5	165	41.3	.14	.53	0.90
21	F	"	"	"	"	1.0	177	44.3	.11	.53	0.77
(6)	F	"	"	"	"	1.5	190	47.5	.10	.53	0.76
22	F	"	"	"	"	2.0	213	53.3	.11	.53	0.72

by a steel scale attached to a mirror at the center of the span. A fine wire was stretched from the approximate neutral axis of the sections at the supports, and the tension was maintained by a spring. An 8-inch Berry strain gauge equipped with an Ames dial reading to 0.0002 inch was used to measure the elongation of the steel and compression in the concrete. Steel buttons were set in the concrete on top at the center of the section, and holes were drilled to fit the Berry instrument. Inasmuch as the buttons were flush with the top of the section, the readings gave the actual deformation of the outer fibers.

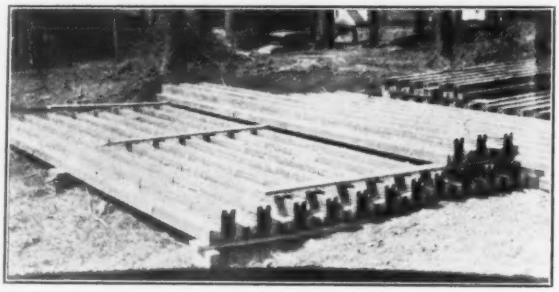

FIG. 2.—Beams stacked ready for use.

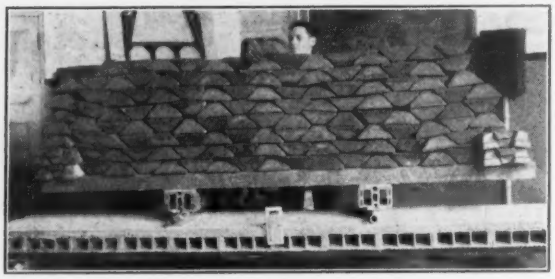

FIG. 1.—Beam No. 5, deflection 0.45 inch.

Steel pegs, welded to the reinforcing rods and extending approximately to the lower surface of the beam, were used in a similar manner to ascertain the deformation of the steel.

The floor sections were rigid, especially in the shorter spans, and carried safely very large loads, *e.g.*, section No. 4 (8-foot span) had a deflection of 0.23 inch under a live load of 12,192 lb. at the third points, equivalent to 871 lb. per sq. ft. live loads. The deflection up to this point progressed at a uniform rate. The allowable deflection of 1/360 of the span equals 0.267 inch. Section 5 reached its allowable deflection of 0.40 inch under a live load of 320 lb. per sq. ft. and failed at 364 lb. per sq. ft. Section 6, which was considered the typical floor for residential use, reached the allowable deflection of 0.533 inch at 149 lb. per sq. ft.

(1) Conclusions on Test Data

(1) All failures of the typical floor sections, with one exception, were caused by the yielding of the steel.

(2) The compression area of the section was stronger than the tension area although only 1/2 inch of concrete topping was used.

(3) There were no shear, compression, or bond failures in the test except in the section using the large 1-inch round rods.

(4) The maximum diameter of the reinforcing rod that the beam will accommodate is 7/8 inch, with the beam tile size as used in these tests.

(5) The 24-inch filler tile can be used in all cases except for heavy loads or spans longer than 16 feet.

(6) The 4-inch filler tile is the most convenient to

insure good anchorage without an excessive amount of concrete.

(7) The cost per square foot of the reinforced tile floor increases materially if spans are greater than 16 feet.

(8) The floor is capable of supporting loads many times the load assumed in residential design.

(9) The deflection of spans under 20 feet at the design load is less than the allowable limit of $^1/_{360}$ of the span.

(10) As steel is the controlling material of the floor, ordinary T-beam reinforced concrete formulas may be used in its design.

(11) The design is flexible and the length and spacing of the beams are easily adjusted to fit the dimensions of the floor plans.

FIG. 3.—Beams and part of span tile in place, Benson Medical Center, Omaha, Neb.

V. Other Tests

In addition to the tests described, several demonstrations were made in Des Moines, Iowa; Lincoln, Nebraska; Lead, South Dakota, and Iowa City, Iowa; all of these test floors met the requirements.

The Des Moines floor consisted of a 12-foot span with beams reinforced with $2^5/_8$-inch bars and spaced 16 inches on centers, using 12-inch filler blocks and a $1^1/_2$-inch concrete topping. A live load of 40 lb. per sq. ft. produced a deflection of 0.009 inch. An 80-lb. live load produced a deflection of 0.018 inch which increased to 0.025 inch after a 24-hour period. The floor was only eight days old when the test was made.

A similar test was made in Lincoln, Nebraska. A section comprised three beams, spaced 28 inches on centers and 14 feet 3 inches in length, and supported at the ends on tile walls. Four-inch filler blocks were used. The test was made fourteen days after completion of the work. A live load of 53 lb. per sq. ft. produced a deflection of only 0.056 inch. The section failed under a live load of 293 lb. per sq. ft.

At Lead, South Dakota, a section, consisting of five beams, spaced 21 inches on center and 13 feet long, was tested by PWA engineers. The section, designed for a live load of 200 lb. per sq. ft., failed at 893 lb. per sq. ft. (The PWA engineers approved the design for a floor to be used in a fire station.)

An acceptance test was made of the floor in the drill hall of the armory for the Armory Building Corporation of Iowa City, Iowa. The beam and slab floor was designed for a uniform load of 125 lb. per sq. ft. The test section, 6 feet 6 inches by 29 feet 8 inches, was loaded to 250 lb. per sq. ft. and allowed to remain 24 hours on one panel and 48 hours on another. The registered engineer, responsible for the test, reported that "since the panel tested showed deflections less than one third of those permissible and developed no signs of cracking, it is concluded that the floor is safe for the design load."

Literature References

(1) The following papers by E. E. Krauss and Judson Vogdes were published in *The Journal of the American Ceramic Society* in Vol. 15, May, 1932: (*a*) "Results of Test on Ten Demonstrations of Reinforced Brick Structures with Summary Covering Tests on Thirteen Structures," pp. 273–300; (*b*) "Method of Testing Reinforced Brick Masonry Demonstration Structures," pp. 300–305; (*c*) "Preliminary Outline of Program of Research in Reinforced Masonry," pp. 305–313; (*d*) "Tentative Specifications for Reinforced Brick Masonry," pp. 313–320.

(2) E. E. Krauss, Judson Vogdes, and J. R. Shank, "Results of Tests on Seven Demonstration Structures with Summary Covering Tests on Twenty Structures," *Bull. Amer. Ceram. Soc.*, **12** [6] 166–97 (1933).

(3) J. B. Davidson, "Modern Silo Construction," *Iowa State Coll. Agr. Expt. Sta. Bull.*, No. 141 (1913).

(4) Henry Giese, H. J. Barre, and J. B. Davidson, "Masonry Barn Design and Construction," *ibid.*, No. 207 (1936).

(5) Henry Giese and J. B. Davidson, "Design and Construction of Masonry Water Supply Tanks," *ibid.*, No. 302 (1933).

(6) H. Filippi, "History of Reinforced Brickwork," *Contract Record*, **47**, 60–62 (1935).

(7) D. E. Parsons and A. H. Stang, "Test of Composite Beams and Slabs of Hollow Tile and Concrete," *Bur. Stand. Jour. Research*, **4** [6] 815–49 (1930); *Ceram. Abs.*, **9** [8] 641 (1930).

(8) Mason Vaugh, "Reinforced Brickwork," *Mo. Univ. Engr. Expt. Sta. Bull.*, **29**, p. 37 (1928).

(9) J. W. Whittemore and P. S. Dear, "Investigation of Performance and Characteristics of Reinforced Brick Masonry Slabs," *Bull. Va. Polytechnic Inst.*, **25** [9] 63 pp. (1932); *Ceram. Abs.*, **11** [11] 570 (1932).

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AN INTERESTING NEW GRINDING PROCESS*

By H. G. Wolfram

I. Introduction

The process of grinding materials involves their fracture or breaking down so that smaller sizes may be obtained. For coarse grinding, a crusher will suffice, wherein the materials are subjected to great pressure between two metal surfaces, but abrasion is necessary for finer grinding. The major action of a ball mill, for example, is that of abrasion plus some impact from the falling ball, whereas a dry pan depends upon abrasion and the crushing action of the heavy rotating mullers.

The hammer mill recently has come into favor for finer grinding, and for very fine grinding a so-called "colloid" mill has been used. None of these methods is entirely satisfactory for all purposes, because they depend upon the disintegration of the materials against dissimilar surfaces, which invites contamination. The particle-size varies widely in most cases so that the use of some method of classification becomes necessary.

Men have dreamed and experimented for many years with other types of grinding, but it was not until three years ago that the son of a New Jersey orchardist discovered the solution to the problem while experimenting with insecticides. Modern insecticides contain a considerable amount of sulfur, and the proper suspension has been maintained with difficulty, owing to the nonwetable characteristics of the material. To grind the sulfur finer, a considerable amount of inert material must be introduced. The presence of this material increases the cost of the operation and does the sprayer no good. The inventor thus realized that his problem was one of reducing sulfur fine enough to increase its wetability without the use of the objectionable filler.

II. Micronizer Grinder

The result of his experiments was an entirely new concept of grinding principle which proved so satisfactory that he was moved to experiment with the device in grinding other materials, and his business has now changed from the production of wetable sulfur to the design and manufacture of micronizer grinding units.

The micronizer unit involves a revolutionary departure from normal grinding methods. The materials to be ground are pulverized by the impact of the particles against each other and without the use of dissimilar surfaces. The machine not only grinds, but classifies, producing a product of much more uniform size than has been previously possible. It has been found that many other materials, like sulfur, exhibit new and improved properties when reduced to a particle size of nearly a micron.

The micronizer may be roughly described as a miniature whirlwind. It consists of a small cylindrical chamber of rather shallow depth in which the peripheral wall has been pierced with small jets or orifices, positioned at an angle tangential to an imaginary circle which is located about one quarter of the distance to the center of the chamber from the wall and midway between the top and bottom plates. Air or steam at high pressure is introduced through these jets, giving rise to a miniature tornado, the peripheral speed of which is estimated to be more than 700 miles per hour. A collecting tube is located in the center of the chamber which extends almost to the upper plate of the chamber, and directly above this but slightly smaller in diameter is the outlet duct for the air or steam used in grinding.

When the materials to be ground are introduced into the chamber, they are caught up into the whirlwind, and as they pass the various jets, the particles are thrown up against each other with terrific force shattering themselves. Owing to the centrifugal force of the rapidly revolving air stream, the materials tend to classify themselves; the coarser particles travel on the outer rim of the stream, and the finer particles tend to travel toward the exhaust chamber in the center. The outlet circle between the top plate and the collecting tube is so graduated as to maintain a pressure in the chamber. The outflowing gases, however, carry the finer materials from the inner circle of the rotating gas column into the collecting chamber. The pressure here is reduced instantly to atmospheric so that the ground material is dropped into the collecting bin and the gases pass off through the vent. By regulating several factors involved, such as the rate of feed, the pressure of the steam or air used, and the positioning of the collecting tube, it is possible to vary the grain size of the materials being ground as desired.

III. Application of Micronizer

This machine has found many interesting applicasions, especially in industries where uniform particle size and the prevention of contamination are necessary; thus, in the manufacture of face powder, the micronizer unit has been found to improve the product. In grinding graphite for pencil leads, the micronizer makes possible a thinner and smoother writing lead than could be obtained previously. Materials, such as sulfur and explosives, which were difficult to grind either because of their chemical nature or their tendency to melt under pressure, may be ground with ease and safety in the micronizer.

In the realm of food products, such materials as vanilla, cocoa beans, and the like may be readily ground to a more satisfactory fineness than was previously possible.

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Enamel Division). Received April 19, 1939.

IV. Micronizer Clay Grinding

In the ceramic industry, the application of the new machine to refining clay is of great interest. Owing to its intrinsic principles, it is possible with this machine not only to grind the clay finer than was previously possible but also to remove the contaminating and accessory minerals which have caused so much grief in the enameling industry. The chief contaminating materials, such as flint and pyrite, which are much harder than the clay and are present in considerably less quantity, are not ground in the micronizer. They merely continue to rotate around the outer periphery of the traveling stream of air and clay and may be removed simply by venting the machine at intervals during the process.

It is unnecessary to dry the clay as in other dry refining processes; in fact, clays containing from 1 to 25% moisture have been processed successfully in the micronizer. The resultant product is essentially a bone-dry material.

Many organic contaminants, furthermore, are removed by the micronizing process. Particles which are harder than clay do not grind, and softer particles grind finer than the clay and are carried off in the air exhaust.

The effect of the micronizing process upon the physical properties of materials ground therein is most interesting. It has already been explained how the wetability of sulfur is markedly increased and how the graphite for pencil leads has been improved. The same holds true for every other product subjected to this treatment. The vanilla bean, for example, is a more desirable ingredient for ice cream than the extract, but it could not be used because it discolored the ice cream and gave it the appearance of containing dirt. It is believed that the micronized vanilla bean has removed this difficulty and has made possible an improved dessert for our homes.

The effect of the micronizing process on clays is interesting. Not only is a clay produced of superior cleanliness, but the increased fineness of the particles increases the wetability of the material, allowing it to begin its work of suspending immediately upon being introduced into the mill. This property should be valuable in the present experiments with pregrinding of wet-process enamels.

The increase in the fineness of clays by the micronizer process in many cases improves their quality of suspension. The use of the micronizer has improved the suspending qualities of slightly inferior domestic clays to a point where they are comparable with German Valendar clay.

The opacity of the resulting product in many cases has also been improved. Owing to the increased fineness of particle size, a better gloss and surface texture may be obtained with micronized clay than was possible with the original crude product.

The micronizer is such a new and radical invention that its field of usefulness has only been touched. Those who have experimented with the device almost daily find some interesting new experiment or use to which to put it. The course of this new development will be interesting to watch because, from present indications, the processes involved may make possible many new and interesting changes in the fields to which it finds application.

The use of this process in the ceramic field has been confined largely to the processing of clays. In view of the many grinding processes necessary in the ceramic industry, however, it is reasonable to suppose that the micronizer in the future may simplify and improve in many respects the present practice.

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SOLUTION OF AN UNUSUAL BRICK MANUFACTURING PROBLEM *

By Frank E. Lobaugh and Harold C. Harrison

Abstract

Knobs about one inch in diameter and white spindling growths as much as six inches long developed during the manufacture of building brick. With the use of the spectrograph, zinc metal was discovered to be the cause of the growths. The zinc came from metal used to hold the tires on the mullers. The phenomena were accurately duplicated by laboratory experiment.

I. Introduction

Unusual problems in the manufacture of brick are not uncommon, but this type of problem does not offer serious manufacturing difficulties and therefore does not require much attention. The plant superintendent is usually too busy to spend much time on minor difficulties, and the facilities and equipment in the average brick plant are often insufficient to work out the solutions. Such is the case discussed in this paper. The problem is interesting, but it is one that would not impair the quality of the product to a great extent.

Peculiar growths appeared occasionally on brick drawn from the kiln. These growths were (1) a thin,

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Structural Clay Products Division). Received April 18, 1939.

white, whiskerlike growth, (2) a somewhat thicker, wormlike growth, and (3) a tan knoblike growth. The whiskerlike growth was smooth, very brittle, and fragile; the wormlike growth was less fragile and was covered on the outside with a white powder. Both of these growths were tubular in the center with the end closed; the inside had a greenish glasslike structure. The knoblike structure was vitreous on the outside and the inside was very porous.

The brick plant where this phenomenon occurred is located in New York State. Shale is used and the product is fired in a tunnel kiln to cone 03.

II. Procedure

This phenomenon happened at a time when a new part of the shale bank was being opened and it was thought that something in the newly won shale was causing the trouble. An investigation of the shale bank showed an abundance of quartz pebbles and pieces of rotten granite. Test pieces with each of these ingredients finely ground and placed in pockets in the shale pieces were made up, but no growths appeared after they were fired.

Samples of each type of growth were brought to this laboratory and were subjected to a spectrographic analysis. The same materials were present in each type, *viz.*, zinc, lead, tin, bismuth, antimony, and silica.

The origin of these materials was a mystery. It was first thought that a special alloy may have been used in the bearings of one of the machines in the plant and, owing to lack of a lubricant, small pieces of the bearing metal may have been cut out and dropped into the screened shale. A check-up at the plant disclosed that no special bearing metal had been used.

In order to duplicate these growths, test pieces were made of the shale with alloys of the different metals in various amounts. The test bars were fired in a muffle kiln to cone 1 in twelve hours (equivalent to the longer firing to cone 03 in the tunnel kiln).

Although no growths appeared, some interesting results were obtained, especially with those alloys containing lead and copper. The alloys containing lead melted and formed glassy spots and those with copper formed black slag spots on the surface. Further investigations will be made to check the effect on the faces of brick.

Pieces of the individual metals were next embedded in shale bars and fired. In addition to the metals present, according to the spectrographic analysis, pieces of the following metals were also embedded in shale bars and fired, *viz.*, copper, magnesium, aluminum, selenium, cadmium, nickel, calcium, and tungsten.

III. Results

At 1750°F, bright, bluish-white flames came from the test pieces that contained zinc metal. As the flames burned, white spindling growths were built up. After the flames ceased, the kiln temperature was raised until cone 1 went down, but no growths appeared on the test pieces containing any of the other metals. The kiln temperature was then raised to 2200°F to see whether any of the other metals would volatilize and form growths, but none was found. As the shale pieces became more vitrified with the higher temperature, knobs grew on the test pieces containing zinc. These results were obtained in a small muffle kiln in twelve hours. No whiskerlike growths were obtained in the 12-hour firing. Another test was made in which smaller pieces of the zinc metal were embedded nearer the surface of the shale pieces and were fired in 24 hours. This produced the whiskerlike growth.

IV. Discussion

At 1750°F and above, the zinc metal volatilized and sufficient pressure was exerted by the vapor to force its way through the shale surface. When the zinc vapor reached the surface of the shale piece, it burned with a bluish-white flame, took on oxygen from the kiln atmosphere, and formed zinc oxide. The zinc oxide built up layer upon layer and formed the wormlike growths.

The whiskerlike growth was formed under similar conditions except with a slower fire and with smaller pieces of the zinc metal near the surface of the shale piece.

At 2200°F, the surface of the shale pieces became vitreous and plastic. The entrapped zinc vapor from the deeper embedded zinc pieces exerted a pressure which forced the surface outward, not unlike that of blowing a soap bubble. The inside of this so-called bubble was a spongy mass and the outside was a vitreous skinlike substance.

V. Conclusions

The three types of growths which occurred at the brick plant were accurately duplicated in the laboratory. The type of growth was dependent upon the size of the zinc particle, its depth in the shale piece, and the temperature and the length of the firing.

The plant officials recalled the fact that pig zinc was used to hold the tires on the mullers of the grinder. One of the tires became loose, and pieces of the zinc were carried on to the screens. An occasional hole in the worn screens allowed the zinc pieces to pass through into the screened shale, then on to the pug mill, and finally into the brick. The other metals, in addition to the zinc, were impurities in the pig zinc.

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Alfred, New York

The 1939 Third Quarter Mark

Shows Growth in Productivity and Substantiality

OUR PUBLICATIONS

To publish more information in spite of increased printing costs, the Publications Committee adopted smaller type and tighter setting, giving 1/5 more type per page in the *Journal* and the *Bulletin* and 1/4 more type per page in *Ceramic Abstracts*. Publication increase through September is shown here in terms of equivalent pages.

	No. of pages (through September issue)	
	1938	1939
Journal	332	$312 + \frac{312}{5} = 374$
Abstracts	320	$260 + \frac{260}{4} = 325$
Bulletin	384	$352 + \frac{352}{5} = 422$

In 1938, through September, 43 research reports and the Phase Rule Diagrams appeared in the *Journal*. In 1939, the count is 55 research reports.

OUR FINANCES

In spite of the continued depression, The Society is rebuilding its invested reserve which was depleted during the years of 1928 to 1933. The Society does not owe, has written off all of its office equipment and book stock, and has so gaited its activities as to continue during the last three months as it did during the first nine months of 1939.

OUR MEETINGS

The 1939 Annual Meeting in Chicago was the largest and most profitable of the series of forty-one such Meetings. The Golden Gate Meeting in August was very successful and productive. The four Autumn Division Meetings were more largely attended and enjoyed than in previous years. The Local Sections and Student Branches held excellent meetings up to vacation time. Prospects for the Winter meetings and for the big Annual Meeting, April 7–13, 1940, in Toronto are bright.

PAID MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
September 19, 1938	1738	216	37	580	220	2791
September 30, 1939	1816	235	35	630	220	2936
Increase	78	19	2 (decrease)	50		145

OUR MEMBERSHIP SUPPORT

The data on paid members and subscribers show an increase. This increase, however, does not reflect the possible member support which this Society should and could have. In spite of its substantiality and proved value over a period of four decades, the importance of this Society to ceramic persons and corporations must be continually stressed.

MEMBERSHIP ROSTER OF THE AMERICAN CERAMIC SOCIETY

The Roster of paid members is being published for the use of the members of The Society. The list is alphabetical; Corporation Members are in black-face type, the name of the voting representative following in parentheses; Fellows are preceded by *; Charter Life, Life, Honorary, and Student Members are indicated after their respective names.

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Anderson, Peter, Shearwater Pottery, Ocean Springs, Miss.
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Ball Brothers Co. (G. A. Ball), Muncie, Ind.
Ball, G. A., Ball Brothers Co., Muncie, Ind.
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Barrett, Maurice, 66 Norton Rd., Morecambe & Heysham, England.
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Bartholomew, Tracy, Duquesne Slag Products Co., 808 Diamond Bank Bldg., Pittsburgh, Pa.
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Bartlett, E. E., Bartlett-Collins Glass Co., Sapulpa, Okla.
Bartlett, Willard J., 1133 East 152nd St., Cleveland, Ohio.
*Barton, G. E., 227 Pine St., Millville, N. J.
Bassett, Robert, Fiske Brick and Granule Co., Darlington, Beaver County, Pa.
Bates, Harry C., Owens-Corning Fiberglas Corp., Newark, Ohio.
*Bates, P. H., 3835 Livingston St., N. W., Washington D. C.
Bauer, Wolf G., Roche Harbor Lime & Cement Co., Roche Harbor, Wash.
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Bausch & Lomb Optical Co. (Murray Scott), Rochester N. Y.
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Berkelhamer, Louis H., Saranac Labs., Box 551, Saranac Lake, N. Y.
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Betzner, W. G., Upson-Walton Co., Cleveland, Ohio.
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Bloor, C. A., Universal Clay Products Co., Sandusky, Ohio.
Blue Ridge Glass Corp. (J. H. Lewis), Kingsport, Tenn.
Blume, Arthur J., Square D Co., Peru, Ind.
*Blunt, Roy A., Buck Glass Co., Fort Ave. & Lawrence St., Baltimore, Md.
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Bonnot Co. (B. T. Bonnot), Canton, Ohio.
Bonnot, B. T., Bonnot Co., Canton, Ohio.
Booth, Franklin, Sierra Talc Co., 428 Union League Bldg., Los Angeles, Calif.

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Central Silica Co. (R. G. Hay), Zanesville, Ohio.
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Cronin, W. K., Cronin China Co., Minerva, Ohio.
Cronn, Eduard, Schwarzwaldbahn, Hornberg, Germany.
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Crossley Machine Co. (William J. Harris), Trenton, N. J.
Crossman Co. (F. M. Crossman, Jr.), South Amboy, N. J.
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Vickers, Arthur E. J., Hazeldene, Junction Rd., Norton-on-Tees, Durham, England.

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Vielhaber, Louis, Lippestr. 11, Duisburg, Germany.
Vieweg, Hermann, 323 Lawrence Ave., Highland Park, N. J.
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Vitro Manufacturing Co. (E. M. Fleck), Corliss Sta., Pittsburgh, Pa.
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INTERNATIONAL CLAY MACHINERY CO., R. H. McElroy (voter), 1145 Bolander Ave., Dayton, Ohio.

Personal

AUSTIN, LEWIS M., 16 Oak St., Salem, N. J.; glass engineer, Gayner Glass Works.

BREENE, GEORGE A., Industrial Colloids Co., Emlenton, Pa.

CLEVELAND, HUGH M., Standard Tile Co., Zanesville, Ohio; ceramic engineer.

COLLINS, GARLIE F., 301 N. Third, Henryetta, Okla.; plant chemist, Pittsburgh Plate Glass Co.

COLTON, HAROLD S., Box 601, Flagstaff, Ariz.; director, Museum of Northern Arizona.

COURT, ANDREW T., 2–158 General Motors Bldg., Detroit, Mich.; Automobile Manufacturers Assn.

EKHOLM, L. G., 1918 Evans Ave., McKeesport, Pa.; quality observer, Carnegie-Illinois Steel Corp.

HALLER, P., 9, Lemington Ave., Halifax, Yorkshire, England; John G. Stein & Co., Ltd.

HARTMAN, ELEANORE P., 1525 Alameda Ave., Lakewood, Ohio; head of Brett Hall, Cleveland Public Library.

HUNT, HERBERT J., Kimble Glass Co., Vineland, N. J.

MUELLER, JAMES I., 11 West 37th St., Anderson, Ind.; ceramic engineer, National Tile Co.

NELSON, WILLIAM S., 201 N. Franklin St., Brazil, Ind.; assistant ceramist, Arketex Ceramic Corp.

NORWOOD, JOHN N., Alfred Univ., Alfred, N. Y.; president.

NUSSBAUM, ERNST, 2045 Oak St., San Francisco, Calif.; teacher, Humboldt Evening High School.

OWENS, JAMES S., 817 Third St., Lancaster, Pa.; research physicist, Armstrong Cork Co.

SESSLER, HATTIE K., 24 Sanford St., Painesville, Ohio; teacher, Mayfield Road School.

SMITH, DUDLEY C., Kimble Glass Co., Vineland, N. J.

STRAIGHT, LEE H., 1306 Main St., Adel, Iowa; field engineer, Straight Engineering Co.

Student

University of Illinois: ALBERT R. LESAR.
Iowa State College: H. FORD MUECKE.
New York State College of Ceramics: EDWARD J. BLAND, MARGARET E. DIEHL, MORRIS C. MUSGRAVE.
University of North Carolina: JAMES N. SMITH, JR.
Ohio State University: ANN T. WRIGHT.
Pennsylvania State College: Joel Levin.

* Membership Workers' Record in November *Bulletin* will include names for this list.

CENTRAL OHIO SECTION

Farewell Meeting for Walter C. Rueckel

Members of the Central Ohio Section met at the Executive Offices of The American Ceramic Society Friday evening, September 29. The meeting was planned as a Central Ohio Section "send off" to the Chairman of the Section, Walter C. Rueckel. Dr. Rueckel is returning to Pittsburgh to rejoin the staff of the Koppers Company and will transfer his activities to the Pittsburgh Section.

The members spent the evening studying additions to the ceramic exhibits and to the library in The Society's Executive Offices. In addition to Dr. Rueckel, the other honor guests of the evening were the newly appointed members to the research staffs at Ohio State University, Battelle Memorial Institute, Orton Ceramic Foundation, and the industrial plants of central Ohio.

G. H. Duncombe, Jr., *Secretary*, expressed the appreciation of the Section to Dr. Purdy and his staff for the entertainment and the refreshments served.

EXECUTIVE OFFICE STAFF NEWS

Miss Mary J. Radcliffe, assistant editor of *Ceramic Abstracts*, was married to Francis R. Gibb on September 27.

Miss Dorothy J. Turner, also an assistant on *Ceramic Abstracts*, was married on September 30 to Paul C. Wallace.

Mrs. Gibb and Mrs. Wallace will continue their positions on the editorial staff of this Society.

Miss Jean Ogden, secretarial assistant, celebrated her marriage to Robert J. Cavanaugh on September 9. Mr. and Mrs. Cavanaugh make their home in Zanesville, Ohio.

NECROLOGY

KATHARINE TROSTEL

A large number of our members remember the gracious Katharine Trostel, wife of Louis J. Trostel. She attended several of the Annual Meetings and the Autumn Meetings of the Refractories Division. She had many friends among the members of The Society.

Katharine passed away Thursday, September 14, 1939, and she was laid away in Columbus on September 16. To Louis Trostel, her husband, to her children, and to her father and brother is extended our sympathy.

THOMAS H. SANT

Thomas H. Sant, clay broker, died in an East Liverpool, Ohio, hospital on August 11, 1939, following three weeks illness. Mr. Sant was born in Stoke-on-Trent, England, in 1877. Following his graduation from Orme School, he studied six years in France, Switzerland, and Spain, and for three years was associated with the Foreign Department of Wenger's, Ltd. He came to East Liverpool in 1904 to establish a clay brokerage business, the Thomas Sant & Sons Company. Upon the death of John Sant in 1914, he became president of the company.

Thomas H. Sant

Mr. Sant joined The American Ceramic Society in 1904 and was active in the Pittsburgh Local Section meetings.

SCHOOL NOTES

CARL H. ZWERMANN

Carl H. Zwermann has received an appointment as Acting Head of the Department of Ceramics, University of Washington, Seattle, Wash. Mr. Zwermann obtained his B.S. degree in Ceramic Engineering at the University of Illinois in 1929. For the next six years, he was ceramic engineer, and later chief ceramist, for W. A. Case & Son Mfg. Co., Robinson, Ill. While working for this company, he gained experience in all phases of the manufacture of vitreous sanitary ware.

In 1937, Mr. Zwermann returned to the University of Illinois to obtain his M.S. degree. His thesis, "Colored Enamels," laid particular stress on the factors causing variations in shades and colors. Mr. Zwermann received his Ph.D. degree in June, 1939. His thesis subject was "Relation of Particle Size and the Characteristics of Light Reflected from Porcelain-Enamel Surfaces." Particular emphasis was placed on extremely fine-milled enamels, and excellent results were obtained.

Carl H. Zwermann

Mr. Zwermann has been a member of The American Ceramic Society since 1934.

Mr. Zwermann's father, the late Carl H. Zwermann, Sr., was an active supporter of The Society. His membership in The Society extended from 1917 until his death in 1934.

Wendell P. Keith, Illinois, '34, has been appointed as instructor in Ceramics in the same Department.

PITTSBURGH SECTION

The Pittsburgh Section of The American Ceramic Society held its first meeting of the season October 10, 1939, in Mellon Institute auditorium. R. E. Birch, Harbison-Walker Refractories Co., spoke on "Mechanical Evolution in Ceramics, 1770–1870."

—C. L. THOMPSON, *Secretary*

NOTES AND NEWS

OHIO CERAMIC INDUSTRIES ASSOCIATION

The Ohio Ceramic Industries Association will hold its annual fall meeting October 27 and 28, 1939, at Ohio State University, Columbus, Ohio.

NEW YORK SOCIETY OF CERAMIC ARTS LAWRENCE E. BARRINGER, PRESIDENT MEETING AND EXHIBITION

Meeting and Exhibition

The New York Society of Ceramic Arts is planning a meeting to be held at the Metropolitan Museum of Art some time the latter part of October; Wheeler Williams will discuss ceramic sculpture. Plans have also been made for the Thirty-Ninth Annual Exhibition to be held at the Argent Galleries on 57th St., New York, N. Y., from November 27 to December 9, 1939.

CERAMIC ASSOCIATION OF NEW JERSEY FALL MEETING

This meeting will be held at the Department of Ceramics, Rutgers University, on Saturday, October 21. This will be largely a social meeting.

The morning session will be devoted to the reading and discussion of papers.

A buffet luncheon will be served in the laboratories of the Department to those in attendance including the ladies. After luncheon, the group will attend the Rutgers-Maryland football game at the new Rutgers Stadium.

Tea will be served in the Ceramics Auditorium after the game.

SIXTH ANNUAL MEETING, CERAMIC ASSOCIATION OF NEW YORK

The Sixth Annual Meeting of the Ceramic Association of New York will be held at the New York State College of Ceramics, Alfred, N. Y., October 20, 1939. The program will consist chiefly of reports of the research work of the Ceramic Experiment Station during the past year. The accomplishments will be presented as papers and will be illustrated by charts and exhibits of the test specimens. Papers on whiteware, heavy clay products, refractories, enamels, and plasters will be presented at this meeting. In addition to the research reports, there will be a general discussion of the research program for the coming year, an address by a prominent speaker, and the election of officers for the coming year. Anyone interested is invited to attend this meeting.

Some of the papers which will be presented at this meeting are as follows:

(1) "Effect of Wetting Agents and Other Additions on Properties of Dry-Mixed Whiteware Bodies."

(2) "Development of Standard Methods of Testing Efflorescence on Masonry Materials."

(3) "Use of Aluminum Metal Powder in Fire-Clay Refractories."

(4) "A Study of Changes Taking Place in Firing of Aluminum Fire-Clay Refractories."

(5) "Ability of New York State Brick to Pass Recently Proposed A.S.T.M. Specifications."

(6) "Effect of Aluminum Powder on Some Properties of Magnesite-Chromite Refractories."

(7) "Development of Viscosity and Other Control Tests for Enamel Frits."

(8) "A Study of Bonds for Silicon-Carbide and Graphite Bodies."

(9) "Use of Aluminum Powder as a Bonding Agent in Silica Brick."

(10) "Effect of Firing Dinnerware with a Reducing Kiln Atmosphere on Vitrification Range of the Same."

(11) "Use of Retarders as a Means of Improving Strength of Pottery Plaster."

(12) "Use of Lepidolite as a Flux in Whiteware Bodies."

(13) "Some Applications of Spectroscopy to Ceramic Problems."

(14) "Effect of Soda Addition on Some Properties of Brick."

SYMPOSIUM ON TEMPERATURE, ITS MEASUREMENT AND CONTROL

The Symposium on Temperature, Its Measurement and Control in Science and Industry will be held in New York, N. Y., November 2–4, 1939, at the Hotel Pennsylvania. It will be presented by the American Institute of Physics, 175 Fifth Ave., New York, N. Y., with the coöperation of the National Bureau of Standards, the National Research Council, and officers and committees of many technical societies.

The program is in charge of representative committees of authorities in various fields, who have arranged for a pro-

gram of one hundred or more papers on scientific and technical subjects which will be presented in concurrent sessions of selected groups. All interested persons active in science or engineering are cordially invited to attend the sessions and take part in the discussions of papers. A complete program containing full abstracts of the papers will be mailed in advance on request to the Institute.

It is suggested that those who expect to attend will inform the Institute and make their hotel reservations early. There will be a registration fee of $1.00. The chairmen of the committees are Gustav Egloff, A. W. Ewell, C. O. Fairchild, J. D. Hardy, H. F. Mullikin, F. H. Norton, R. B. Sosman, C. B. Veal, H. T. Wensel, and G. B. Wilkes. H. A. Barton, Director of the Institute, is chairman of the Main Committee.

EIGHTH NATIONAL CERAMIC EXHIBITION

The Eighth National Ceramic Exhibition, sponsored by the Syracuse Museum of Fine Arts, will be open in Syracuse from October 1 to 30, 1939. It will then be sent on circuit from November 1, 1939, to July 1, 1940. The time on circuit has been extended one month because of increased demand for this nationally representative collection of ceramic sculpture and pottery.

1939–1940 Circuit

November: Cleveland Museum of Art.
December: Memorial Art Gallery, Rochester, N. Y.
January: Oberlin College, Oberlin, Ohio.
February: University of Pittsburgh, Pittsburgh, Pa. (3rd booking).
March: City Art Museum, St. Louis, Mo.
April: Toronto (booked by The American Ceramic Society for Forty-Second Annual Meeting).
May: Munson-Williams-Proctor Institute, Utica, N. Y.
June: Currier Gallery of Art, Manchester, N. H. (3rd booking).

The Jury

The members of the Jury are as follows: *Chairman*, Dorothy Wright Liebes, director, Division of Decorative Arts, Golden Gate International Exposition, San Francisco, Calif.; Russell Barnett Aitken, ceramic sculptor, New York, N. Y., formerly of Cleveland; R. Guy Cowan, art director, Onondaga Pottery Co., Syracuse, N. Y., and representative of The American Ceramic Society; Francis Henry Taylor, Director, Worcester Art Museum, Worcester, Mass.; and Viktor Schreckengost, Cleveland, Ohio, master of design, Cleveland Museum of Art, art director and designer, American Limoges, the Sebring Pottery, and the Salem China companies.

National Ceramic Exhibitions and the Ceramic Industry

Experience has proved (according to R. Guy Cowan) that advances in this industry follow experiment on the part of the individual artist and craftsman. If there is to be any improvement in esthetic standards, the individual artist must advance.

The Syracuse Museum, in the national ceramic exhibitions, gives an opportunity for the industrial designers of the country to exhibit as individuals, untrammeled by any commercial considerations. The exhibition is open to commercial work, but it must be shown as the work of the individual artist-craftsman, for example, Viktor Schreckengost and not the American Limoges Company.

Trade interest has increased as shown by editorial comment on the Sixth National Exhibition entitled "Unearthing Ceramic Talent."

"There are a number of good schools in the country where men are trained for this work, but whereas nearly any intelligent youth with study may become a fairly good ceramist and find a place for himself, to be a ceramic artist is an entirely different matter. He must have a God-given inspiration plus the knowledge.... It is in bringing out such talent that exhibitions, such as those now being held in the Syracuse Museum, do so much good in aiding the artists themselves and the trade as a whole in bringing their work to the attention of the manufacturers."

The same editor, writing last year, said, "The china and glass trade as a whole showed widespread interest in your activities at that time (1937) and we believe that this year's exhibit will be equally interesting."

The European exhibition of contemporary American ceramics inspired much comment in business and trade publications as well as art magazines. *Fortune* discovered American ceramic art in an article well illustrated in color, calling it "the art with the inferiority complex." Comparison of American with European ceramics indicates the inferiority complex might be found in the American public.

As to the relation of the artist to the trade, Waylande Gregory, leading ceramic sculptor known for his monumental work in terra cotta, commented as follows, "If then the fields of ceramics and the designer-craftsman-sculptor could once become truly united, America would have an era of great achievement."

Information Regarding Ceramic Art and American Artists

The Syracuse Museum is gradually assembling valuable information on contemporary ceramic art and ceramic artists which is not available elsewhere. Material on the individual artists is available and every effort is being made to build up this department of information. The Museum will be glad to meet requests for information.

STUDIES OF PURPLE HUES OF GLASS CONTINUES FOR SIX DECADES

In the August 19, 1939, issue of the *Boston Evening Transcript* appeared the following abstract of a paper by Thomas Gatfield, which was published in 1880. This phenomenon is still being studied in 1939.

"I obtained specimens from Strasburg and elsewhere and applied the interesting heat test by dividing some of the specimens in two pieces and exposing one to the heat of a glass-stainer's kiln. Although some ordinary and expected effects were produced, such as the deepening of some of the red and yellow tints by a second firing, no change was produced in the pot-metal colors by heat, which indicated any previous change by sunlight except in the few small purple and flesh-colored specimens.

"The colorless body of the flashed and enameled glasses, with the exception of a slight lightening of the tint, was unchanged, being generally of so dark a color originally that it seemed no change could be effected by light or heat. As far as these purple and flesh (colors and other easily changing tints of pot-metal colors) were used in the old windows and as the same cause must always produce the same effect, we can certainly say that they must have been changed in color or tint by their centuries of exposure. We cannot see today the glass as it was, as it came from the artists' studios and the glass factories of the medieval ages, and so far we may transfer some of our praise from the old artists in glass to the silent but wonderful pencil of the sun.

"Knowing the exact constituents of each specimen, a good foundation would be laid for a thorough and scientific investigation of the subject. This has never yet been done; in the absence of such knowledge we can only theorize upon the results which we witness.

"This action of sunlight must not be confounded with that called "rust" or "stain," which is occasioned in some glasses which have an excess of alkali in their composition by exposure to the atmosphere. It manifests itself in two ways, viz., by a disintegration and roughening of the surface, sometimes producing all the effect of ground glass and by an efflorescence and apparent formation of an infinitesimal coating of oxide upon the surface, on which the play of the sun's rays produces all the colors of the rainbow, as with the action of light on the infinitesimal grooves of mother-of-pearl."

CERAMIC HISTORY

EARLY HISTORY OF THE ELECTRICAL PORCELAIN INDUSTRY IN THE UNITED STATES*

By Arthur S. Watts

My earliest personal acquaintance with the porcelain insulator industry came about in July, 1901, when I accepted a position with Fred M. Locke, insulator manufacturer at Victor, N. Y. During the period of my connection with Mr. Locke and the Locke Insulator Company, which extended to 1909, and through my later associations with several other porcelain insulator manufacturers, I have repeatedly observed a wide difference of opinion as to priority in processes and products in this industry.

I started to compile historical material relating to this industry nearly thirty years ago. My memoranda, dated about 1908, lacked supporting data, and its review inspired me to undertake such confirmation as is available. The following information and the sources are the results of my search.

Union Porcelain Works

James L. Jenson, last president of the Union Porcelain Works, Brooklyn, N. Y.

"I cannot furnish the names of founders or the actual date of founding the Union Porcelain Works, but the works were operating before the Civil War in the manufacture of heavy hotel tableware and hardware trimmings. My grandfather, James L. Jenson, was superintendent for many years prior to 1870 when he purchased the Empire China Works at Greenpoint, Brooklyn, N. Y. I have been told many times that the Empire China Works, located at 156 Greene St., Brooklyn, N. Y., produced the first electrical porcelain insulators in the United States by molding in plaster molds for Waldo Bryant of the Bryant Electric Company of Bridgeport, Conn. These were not high-tension insulators, and the Empire China Works and the Union Porcelain Works never manufactured high-tension insulators. They began to manufacture dry-pressed, low-tension insulators only a few years after the Empire China Works, according to my information and recollections."

Author Note: Inasmuch as the first electric light was not installed until 1871, followed by the electric arc light in 1878, and the first commercial motor in 1880, the early production of electrical porcelain insulators by the Empire China Works was related only to experimental projects, and they were not produced on a commercial scale.

Greenwood Pottery Company

David Crossley, President of the Crossley Machine Company, Trenton, N. J., confirms an article by C. C. Treischel (*Jour. Amer. Ceram. Soc.*, **6** [1] 312–14 (1923)).

"In America, as far as the writer can learn, the first electrical porcelain was made by the dust or dry process, and the credit for this accomplishment goes to the Greenwood Pottery Company of Trenton, N. J. This was in 1879. The articles were two-piece insulators, probably knobs, and were given two firings, one biscuit and one glost. Joseph Crossley of Trenton made the dies used in producing these pieces."

R. Thomas & Sons Company

R. Thomas & Sons Company, East Liverpool, Ohio. (Booklet, "Our 50th Year.")

"In 1873, the firm Richard Thomas & Son was established in East Liverpool, Ohio, to produce doorknobs and specialties. In 1885, the first porcelain insulators were made, going to the U. S. Electric Lighting Company of Chicago at the time of the organization of the National Electric Light Association. In 1887, the company was marketing porcelain insulators to the Brush Electric Association, Detroit Electric Works, Pittsburgh Electric Company, Central Electric Company, Keystone Light & Power Company, Westinghouse Electric Company, *et al.* In 1892, the R. Thomas & Sons Company was incorporated. Its line consisted of three outdoor types of insulator and nearly one hundred designs for interior wiring. All of the porcelains used in the lighting arrangement for the World's Fair in Chicago in 1893, installed by Westinghouse, were 'Thomas.' The third issue of the 'Thomas' catalogue appeared in 1894, and nearly three hundred insulators were illustrated. Early in 1896, the first 'Boch' glaze-filled insulator was perfected, later to be patented. It was the first multipart, high-voltage porcelain insulator manufactured."

Author Note: These dates have been confirmed by members of the early Thomas organizations.

Imperial Porcelain Works

Francis W. Dinsmore, Vice-President, Imperial Porcelain Works, Trenton, N. J.

"The Imperial Porcelain Works was founded in July, 1891, by Frederick A. Duggan, who had been with the Trenton China Company, where in 1888 the manufacture of electrical porcelain was added to the regular line of hotel china and vitrified dinnerware. Benjamin B. Dinsmore, also of the Trenton China Company, went with Mr. Duggan in 1891, later acquiring an interest in the Imperial Porcelain Works. In the beginning, production was confined to dry-pressed or low-voltage porcelain. In the latter part of 1894, Fred M. Locke, of Victor, N. Y., was advertising porcelain insulators for high-voltage transmission and was contacted for permission to quote on his requirements. The quotation was made, the order was received, and with the order came a sample of the insulator that Mr. Locke was having made for him. The sample plainly

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (White Wares Division). Received June 24, 1939.

showed that it had been manufactured by the dry-press process, and rather poorly at that, for it looked like a lot of sawdust that was not much more than held together. Upon inspecting the sample, Mr. Dinsmore told Mr. Duggan that he thought a good insulator for high voltage should be made of plastic clay as he feared such a product as the dry-pressed sample would not resist the specified test of 10,000 volts. Benjamin B. Dinsmore produced the order from plastic porcelain, and specimens which Mr. Locke had tested at Cornell University were highly satisfactory. They were installed in California, replacing an original installation of the dry-pressed insulators, which had failed to stand 11,000 service voltage. The General Electric Company, which had also made and installed dry-pressed insulators in Utah, gave the Imperial Porcelain Company an order to replace these with Imperial high-voltage insulators. About 1896 or 1897, the R. Thomas & Sons Company started the manufacture of insulators made of two shells of plastic body with a center portion of dry-pressed body, all fastened together with glaze. These were named 'glaze-filled insulators,' but they were soon superseded by shells fastened together by cement. About 1897 or 1898, Mr. Locke started to experiment with the manufacture of porcelain." (Information given by Benjamin B. Dinsmore.)

General Electric Company

Frank Cermak, Superintendent, Porcelain Factory, General Electric Company, Schenectady, N. Y.

"August Weber and I have made a thorough investigation of the manufacture of dry-pressed porcelain; we find that the Bergman Electric Company of Seventeenth Street and Avenue A, New York, N. Y., made receptacles and cutouts under the Edison patents. The insulating parts, made of wood, were unsatisfactory owing to their fire hazard. They began an investigation of the possible use of porcelains. John J. Kraus manufactured artistic pottery at East Eighteenth Street, New York, N. Y., and William Cermak, my father, was the foreman. They began experimenting with dry-pressed porcelain in 1887, and they put it into production in 1888. The Bergman Electric Company took the total output. This company was absorbed by the Edison Machine Company, which later became the General Electric Company. Wet-process porcelain used on switchboard work by the General Electric Company was made by the Smith Company of Brooklyn, N. Y., until its production began at Schenectady in 1902."

Pass & Seymour, Incorporated

Pass & Seymour history as furnished by Richard Pass, President of the present corporation.

"The company was founded as a partnership in 1890 by James Pass and Albert P. Seymour. Mr. Pass, a potter, was superintendent of the Onondaga Pottery Company of Syracuse. Mr. Seymour was superintendent of the Syracuse Lighting Company. The firm was created to develop the use of porcelain as an electrical insulator in the lighting industry. The porcelain was essentially the same composition as that developed by Mr. Pass for the Onondaga Pottery Company and it sold as 'Syracuse china.' Plastic molding was used at the start, but dry press was introduced for certain ware about 1891. High-tension insulators were manufactured by throwing and turning during the early years, and later some smaller high-tension insulators were cast. This company manufactured a large quantity of spark plugs by the plastic process and by turning, which was discontinued in 1914. The company's present business is low-tension porcelain wiring and lighting fixtures made chiefly by dry pressing. Some porcelain lighting units and a limited line of high-tension insulating units are cast. No products are made by plastic process at the present time. Periodic updraft kilns, fired by coal, were used from the outset, and these only recently have been partially replaced by a tunnel kiln. The original plant was adjacent to the Onondaga Pottery Company, Syracuse, but it was moved to Solvay in 1900, and the company, Pass & Seymour, Inc., was incorporated in 1901. Mr. Seymour severed his connection with the firm in 1906."

Electrical Porcelain & Manufacturing Company

Carl F. Adam, Trenton, N. J.

"The Electrical Porcelain & Manufacturing Company of that city was incorporated by David Crossley, F. F. and J. L. Waechter, and Mr. Adam on April 18, 1895, under the laws of New Jersey, to manufacture porcelain insulating devices for electrical purposes and any and every kind of porcelain ware for any other use and purpose and to sell such products. In 1895, a contract was entered into with Fred M. Locke to manufacture his patented high-voltage insulators. Mr Adam reports that he induced Jonathan Coxon, Sr., Richard Bryan, and Joseph Mayer, all practical potters operating plants in Trenton, to invest in the company and to assist in the development of vitrified single-fire porcelain. The body was prepared by the normal blunger-filter press process, and the press cakes were reduced to dust by a cyclone-type pulverizer.

"At first a set of permanent magnets was used to remove any tramp iron from the slip, but these were later replaced by the first direct-current electromagnets used in the industry, which were made in my own shop. The ware was formed by means of single- and double-compression dust presses. The first commercial-size kiln was a L. Lawton downdraft, 12 feet in diameter and a 14-foot crown, with four fire mouths for bituminous coal. The first body consisted of English ball and china clay, Florida kaolin, Connecticut feldspar, and French flint. The kiln firing was controlled by dry-pressed rings of the same body as the ware. The rings were 3 inches in diameter by $\frac{1}{2}$ inch thick with a $1\frac{1}{4}$-inch hole in the center. They were placed in top and bottom trial saggers in each quarter, and one was removed every three or four hours. When $12\frac{1}{2}\%$ shrinkage was indicated, the kiln was soaked one to two hours and cooled. These porcelain rings tended to bloat and were replaced by rings of a more open and refractory body which were satisfactory. This was before the introduction of pyrometric cones or Veritas firing disks."

Author Note: Mr. Adam believes that David Crossley produced the first single-fire porcelain and that the first single-fire electrical porcelain was made by himself.

Akron Smoking Pipe Company

Akron Smoking Pipe Company, Mogadore, Ohio. (F. W. Butler, President, Akron Porcelain Co., Akron, Ohio.)

"The Akron Smoking Pipe Company was organized in 1890 by J. W. Baker, J. C. McMillen, C. H. Palmer, F. W. Butler, Sr., and Charles Baird to manufacture stoneware

smoking pipes with reed stems which were given as premiums by the Diamond Match Company. In 1896, the company started to manufacture standard wiring insulators, tubes, knobs, cleats, etc. These were made from a local stoneware clay. The manufacture of smoking pipes was discontinued a few years later and the name was changed to the Mogadore Insulator Company. At this time, the body was changed to a standard electrical porcelain. In 1920, the standard wiring insulator line was discontinued, and since then production has been confined to dry-pressed electric porcelain specialties for individual customers. In 1928, a new plant was built in Akron, and the name again was changed to the Akron Porcelain Co."

G. F. Brunt Porcelain Company

G. F. Brunt Porcelain Company, East Liverpool, Ohio. (W. F. Steele, associated for many years with Mr. Brunt.)

"The original pottery, known as Henry Brunt & Sons, was established at the foot of Market Street, East Liverpool, Ohio, about 1895. One of the sons, G. F. Brunt, with Charles Thompson, began making standard porcelain cleats, tubes, knobs, etc., selling under the name Brunt & Thompson. In 1898, the G. F. Brunt Porcelain Company was formed for the manufacture of this ware and operated in East Liverpool. The operation was moved in 1912 to Worthington, near Columbus, where it continued until 1925 when the business was abandoned and the plant was sold."

Locke Insulator Company

Fred M. Locke, insulator manufacturer, Victor, N. Y. (Compiled from the records of men associated with Mr. Locke in the early years of his insulator development and supported by information in possession of the author of this article.)

John S. Lapp, President, Lapp Insulator Company, LeRoy, N. Y., was associated with Mr. Locke from 1896 until Mr. Locke retired from the insulator business. Mr. Lapp's father was associated with Mr. Locke from a much earlier date, and the first insulator patent credited to Mr. Locke was No. 402,752 issued May 7, 1889, to F. M. Locke and J. Lapp. John S. Lapp reports that in 1894 Mr. Locke contracted with R. Thomas & Sons Company of East Liverpool, Ohio, to manufacture porcelain insulators protected by his patents. He later contracted with the Imperial Porcelain Company of Trenton, N. J., and with Jonathan Coxon, Electrical Porcelain & Mfg. Company of Trenton, N. J., for the manufacture of his patented insulators. During this period, he was also having his insulators made in glass by the Brookfield Glass Company of Brooklyn, N. Y. In 1898, Mr. Locke started the manufacture of plastic-molded porcelain insulators at Victor, N. Y. Mr. Locke's contributions to the development of high-voltage porcelain insulators are evidenced by many early patents in addition to the original referred to. The U. S. patents for insulators issued to F. M. Locke were as follows: 520,367, May 22, 1894; 26,323, Nov. 24, 1896; 573,092, Dec. 15, 1896; 590,806, Sept. 28, 1897; 605,109, June 7, 1898; 32,741, May 29, 1900; and 34,450, April 30, 1901.

Mr. Locke experimented with numerous porcelain and stoneware bodies and glazes in the early years at Victor, N. Y.

According to Walter A. Weldon of Baltimore, Md., M. Brace, Edward Gouldrich, and Van Bennett of Victor, N. Y., all among the first employees at Victor, Mr. Locke started with a body consisting of feldspar, flint, and English and Tennessee ball clays. The glaze consisted of a fusible local clay which gave a light yellow color. Later he attempted to use a Pennsylvania fire clay with this local slip clay as a flux. This body was in production in 1901, but before 1902 it was replaced by the typical high feldspar, high ball clay, low china clay, and low flint porcelain, typical of electrical porcelain bodies at the present time. The body was prepared by wet grinding in large ball mills, followed by screen, filter press, and pug mill. No systematic aging was practiced in the early years. The large units were made by jiggering, and the smaller units were made by plastic pressing on a revolving plunger press with plaster molds. No dry-pressed ware was made during the history of Fred M. Locke or of The Locke Insulator Company.

The first kiln was a 9-foot round downdraft kiln with separate stack, built in the spring of 1898, and this type of kiln with modifications was employed exclusively until after 1910. Mr. Weldon reports that Mr. Locke had trouble with the firing of his first insulators, and he finally took them in a basket to Trenton, N. J., where Messrs. Dinsmore fired them for him and otherwise aided him in his problems.

J. W. Ryan, Superintendent, Porcelain Department, Westinghouse Electric & Mfg. Company, Emeryville, Calif., was an early Victor employee. His recollection is that Mr. Duggan of Imperial Porcelain Company developed the first porcelain body used at Victor. Mr. Ryan points out that before 1902 Mr. Locke combined a porcelain head and a glass center in many of the large insulators of that period. The yellow glaze from local slip clay was soon replaced by Albany slip clay and most of the early production had the latter glaze. The white glaze was introduced in 1901 to 1902. Mr. Locke organized the Locke Insulator Company in 1902 and retired from the management in 1904. He was succeeded by John S. Lapp, whose records have been used in compiling this history.

Star Porcelain Company

Star Porcelain Company, Trenton, N. J. (R. W. Ferguson, President, Star Porcelain Company.)

"The Star Porcelain Company was organized in the spring of 1899 by Charles P. Britton, Thomas W. Mackenzie, and Herbert Sinclair, the latter possessing the knowledge of the manufacturing processes. They manufactured dry-pressed porcelain until 1901, when a line of high-voltage insulators was added under the supervision of a Mr. Grainger (first name not revealed in the records). Both lines were produced until 1907, when the high-voltage line was dropped, and production has since been limited to dust-pressed products."

Anderson Porcelain Company

Anderson Porcelain Company, East Liverpool, Ohio. (G. O. Anderson, President, Superior Porcelain Company, Parkersburg, W. Va.)

"The factory was built and started production in 1900. The officials were T. F. Anderson, *President;* T. B. Anderson, *Vice-President;* and G. O. Anderson, *Secretary-*

Treasurer. In the beginning, only tubes, cleats, and knobs were made, but in 1905 a line of pintype and strain insulators was added. The company was merged with seven other companies in 1911 to form the General Porcelain Company of East Liverpool, Ohio. In 1913, a large plant was built at Parkersburg, W. Va., and all of the other plants were dismantled. In 1927, the General Porcelain Company was merged with four other companies to form Porcelain Products, Inc."

Summary

The history of the electrical porcelain industry has been confused with the dates of origin of the firms that later entered this field. The manufacture of standard low-voltage insulators by plastic molding, furthermore, has been confused with the manufacture of high-voltage insulators.

Historical Data on Electrical Porcelain Insulators

(1) Empire China Works, Brooklyn, N. Y., prior to 1879; made the first low-voltage insulators formed in plaster molds.

(2) Union Porcelain Works, Brooklyn, N. Y., soon after Empire China Works; dry-pressed ware.

(3) Greenwood Pottery Company, Trenton, N. J.; dry-pressed two-fire, 1879.

(4) R. Thomas & Sons Company, East Liverpool, Ohio; low-voltage insulators, 1885; outdoor insulators prior to 1892.

(5) Trenton China Company, Trenton, N. J.; low-voltage insulators, 1888.

(6) John J. Kraus, New York, N. Y.; low-voltage insulators, 1888.

(7) Pass & Seymour, Syracuse, N. Y.; plastic-molded low-voltage insulators, 1890; dry-pressed low-voltage insulators, 1891; some high-voltage insulators made by throwing and turning about same time.

(8) Imperial Porcelain Works, Trenton, N. J.; low-voltage dry-pressed insulators, 1891; high-voltage insulators made for Fred M. Locke in 1894.

(9) Electric Porcelain & Manufacturing Co., Trenton, N. J.; dry-pressed insulators, 1895; high-voltage insulators made for Fred M. Locke, 1895; produced the first one-fire glazed porcelain.

(10) Akron Smoking Pipe Company, Mogadore, Ohio; dry-pressed insulators, 1896.

(11) G. F. Brunt Porcelain Company, East Liverpool, Ohio; dry-pressed insulators, 1897.

(12) Fred M. Locke, Victor, N. Y.; plastic-molded high-voltage insulators, 1898.

(13) Star Porcelain Company, Trenton, N. J.; dry-pressed insulators, 1899; high-voltage insulators, 1901.

(14) Anderson Porcelain Company, East Liverpool, Ohio; low-voltage insulators, 1900.

Department of Ceramic Engineering
Ohio State University
Columbus, Ohio

Note by Editor

The following history and data appear in the valuable and informing book, Marketing Burned Clay Products, by A. Hamilton Chute, Ph.D., published by the Bureau of Business Research, The Ohio State University, Columbus, Ohio, June, 1939; price $3.50.

"Electrical porcelain has been mentioned since about the middle of the Nineteenth Century. The exhibits at the Crystal Palace in New York in 1853 included 'telegraph insulators of white flint,' which were employed on the telegraphs in the vicinity of Boston. Two potteries in different eastern states contended for the honor of having made the first telegraph cups for Morse during his early experiments (1830–1842). A pottery in Kaolin, S. C., during the War, made porcelain and pottery insulators for use on the Confederate telegraph lines. An electrical porcelain plant was reported in Trenton, N. J., in 1865, and another in 1891. A Chicago pottery from 1883 was making porous cells for electric batteries. Electrical porcelain manufacture started in Ohio in 1884 at East Liverpool, Ohio, and, in 1890, at Syracuse and Brooklyn, N. Y.

Percentage Distribution of Value of Total Pottery Products Produced in the United States, 1899–1936

Type of Product	1899	1904	1909	1914	1917	1919	1920	1921	1922	1923	1924
Total Pottery	100	100	100	100	100	100	100	100	100	100	100
Whiteware	45.9	47.4	44.2	42.3	37.2	38.3	35.9	35.3	30.8	33.7	30.7
China and hotel ware	7.7	6.0	5.7	6.7	8.6	9.9	10.6	14.5	9.0	10.2	9.6
Red earthenware	4.5	3.0	2.6	3.0	1.9	1.8	1.7	2.4	3.3	2.1	1.9
Rockingham, yellow, and stoneware†	14.7	14.7	12.9	9.5	8.9	6.9	7.0	7.6	7.4	5.1	4.3
Electrical porcelain	2.7	5.7	9.8	11.7	16.8	16.2	18.9	17.0	17.5	18.5	19.4
Vitreous sanitary ware	12.5	14.3	19.3	22.2	22.5	19.1	20.6	18.2	26.3	24.4	*
Miscellaneous pottery*	12.0	8.9	5.5	4.6	4.1	7.8	5.3	5.0	5.7	6.0	34.1

Type of product	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Total Pottery	100	100	100	100	100	100	100	100	100	100	100	100
Whiteware	29.3	28.8	28.4	29.2	28.6	28.3	30.2	35.5	34.1	34.9	32.5	29.2
China and hotel ware	8.8	8.9	9.0	8.6	9.4	10.7	9.9	10.5	11.4	12.4	10.5	10.7
Red earthenware	2.3	2.3	2.6	2.4	2.5	2.6	3.1	3.1	2.7	2.6	2.6	2.2
Rockingham, yellow, and stoneware†	4.9	5.5	4.9	5.3	4.9	5.1	5.9	7.1	5.0	3.4	2.5	2.0
Electrical porcelain	19.5	21.3	20.5	19.3	19.8	20.0	19.7	15.1	16.0	19.9	18.7	19.4
Vitreous sanitary ware	22.4	19.6	21.2	22.8	22.3	20.6	19.4	17.0	17.6	13.8	19.0	22.2
Semivitreous sanitary ware	*	4.8	4.9	4.3	3.5	3.2	3.0	2.1	1.5	0.9	0.7	0.5
Miscellaneous pottery	12.8	8.8	8.5	8.1	9.0	9.5	8.8	9.6	11.7	12.1	13.5	13.8

† Includes chemical stoneware and chemical porcelain.
* Semivitreous sanitary ware included in "Miscellaneous pottery."

"The early manufacture of electrical porcelain probably consisted largely of household-wiring fixtures and insulating parts, such as lamp sockets and rosettes, switch-bases and fuse-blocks, porcelain tubes, knobs, and cleats. Later, it found limited employment in specially molded parts for electric motors and appliances. High-tension electric insulators for power distribution lines were made by 1903."

PERCENTAGE DISTRIBUTION OF ELECTRICAL PORCELAIN PLANTS AND VALUE OF PRODUCT IN THE UNITED STATES, 1929

State	No. of plants (%)	Value of product (%)
New York	15.9	12.2
New Jersey	8.4	12.7
Ohio	11.7	11.5
Illinois	13.6	18.9
Pennsylvania	7.6	15.1
Indiana	3.2	5.8
Wisconsin	3.4	2.1
Michigan	3.4	2.7
Massachusetts	5.9	8.0
Connecticut	3.3	3.8
California	7.6	1.8
All other states	16.0	5.4

NUMBER OF ELECTRICAL PORCELAIN MANUFACTURING PLANTS LOCATED IN INDICATED STATES IN THE UNITED STATES BY TYPES OF PRODUCTS

State	Insulators (high voltage)	Dry process (low voltage)	Porcelain (light fixtures)	Refractory porcelain
California		4		
Connecticut	1	1	2	1
Illinois	1	2		
Indiana		1	1	1
Massachusetts		1	1	
Maryland	1			
Michigan	1			
Missouri			1	
New Jersey		3	3	7
New York	3	7	6	1
Ohio	5	10	3	9
Pennsylvania	1	1	2	
Rhode Island				
Tennessee	1	1	1	
West Virginia	2	2		2
Wisconsin		2	1	1
Total	16	35	21	22

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THE CENTER OF CERAMIC POPULATION

By Raymond E. Birch

Cecil B. Read, in the July 21, 1939, issue of *Science*, has presented interesting material under the heading "Centers of Population of Learned Groups." In connection with the problem of choosing convenient meeting centers for various scientific groups, he made an exhaustive membership distribution study with the aid of the National Youth Administration. His aim was to determine the center of population for the membership of various societies.

The method used was essentially that of the Bureau of the Census in determining the center of population of the United States. The calculations were based on the latitude and longitude of the post-office address of each member. A modification of this system, based on location and membership of local sections, was used in calculating the center of the American Chemical Society.

The results of this interesting study are shown in Table I.

Except for the American Association of Petroleum Geologists, whose membership is influenced by the location of the western oil fields, the population center of all groups studied was found to be "slightly north and very definitely east of the center of population of the United States, which in 1930 was 39° 3′ 45″ north latitude and 87° 8′ 6″ west longitude."

Mr. Read concluded that "from one point of view, the ideal place for an annual meeting of any one of these societies would be the nearest city to the center of population, for the total number of miles of travel necessary for all members to attend would thus be a minimum. From this point of view, it would certainly seem that Columbus and Cincinnati are excellent convention cities."

This viewpoint could hardly be satisfying to society members residing in faraway states. A more politic convention policy, and the one which has been practiced by a number of societies, consists of a majority of annual meetings near the membership center, with occasional meetings in outlying centers.

Table I

Organization	Number of individuals	Center of population		Nearest city
		Latitude	Longitude	
American Chemical Society by sections	17,469	40° 5′	83° 49′	Dayton
Geological Society of America	562	39° 1′	87° 32′	Indianapolis
American Historical Society	2,926	39° 54′	82° 13′	Columbus
Mathematical Association of America	1,928	39° 32′	84° 57′	Cincinnati
American Association of Petroleum Geologists	2,448	35° 6′	98° 12′	Oklahoma City
American Physical Society	2,653	40° 1′	83° 23′	Columbus
American Psychological Association	2,269	40° 15′	83° 35′	Columbus
American Association of University Professors	11,165	39° 30′	84° 27′	Cincinnati Dayton
American Association for the Advancement of Science	17,141	39° 41′	84° 10′	Dayton
American Speech Correction Society	206	40° 44′	87° 7′	Chicago Indianapolis
American Society of Zoologists	797	40° 5′	83° 39′	Columbus Dayton

Ceramic Membership

It is interesting to compare data on these societies with similar results based on a study of The American Ceramic Society membership. This study, completed before publication of these data, used a less exacting method. The source data were taken from the Geographical Roster appearing on pages 234–54 of the September, 1934, *Bulletin*. A mean latitude and longitude was chosen for each state and Canadian province, based on consideration of the ceramic centers. The total membership in each state gave a figure with which these state centers were proportionately weighted in calculating The Society's membership center for the United States and Canada.

The American Ceramic Society center of population, by this method, was found to be at 40° 20′ latitude and 83° 41′ longitude. This point lies approximately 35 miles west and 25 miles north of Columbus.

Various other calculations were made. In one instance, all states having less than 1% of the total membership were omitted from the calculations. In another instance, only California was omitted. This important ceramic state contains 5.3% of The Society's membership and, because of its far westerly location, was an important factor in the calculations of population center. When omitted from consideration, the result was to move the center of the remaining ceramic population to 40° 30′ latitude and 81° 36′ longitude, which is in the neighborhood of Canton, Ohio.

The results of these and similar calculations are shown in Table II.

It may be concluded that Columbus is a well-chosen center geographically, as well as historically, for the offices of The American Ceramic Society.

Table II

The American Ceramic Society

	Approximate center of population				
	Latitude	Longitude	Nearby city (Ohio)	Miles north or south of Columbus	Miles east or west of Columbus
Entire Society	40° 20′	83° 41′	Bellefontaine	25 N	35 W
Society, except California	40° 30′	81° 36′	Canton	35 N	75 E
Society, except states with less than 1% of membership	40° 54′	84°	Lima	60 N	50 W
Society, except states west of Wis., Iowa, Mo., Ark., and La.	40° 30′	81°	East Liverpool	35 N	100 E

(1939)

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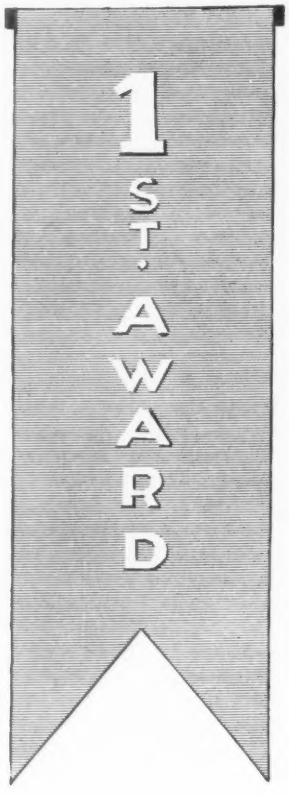

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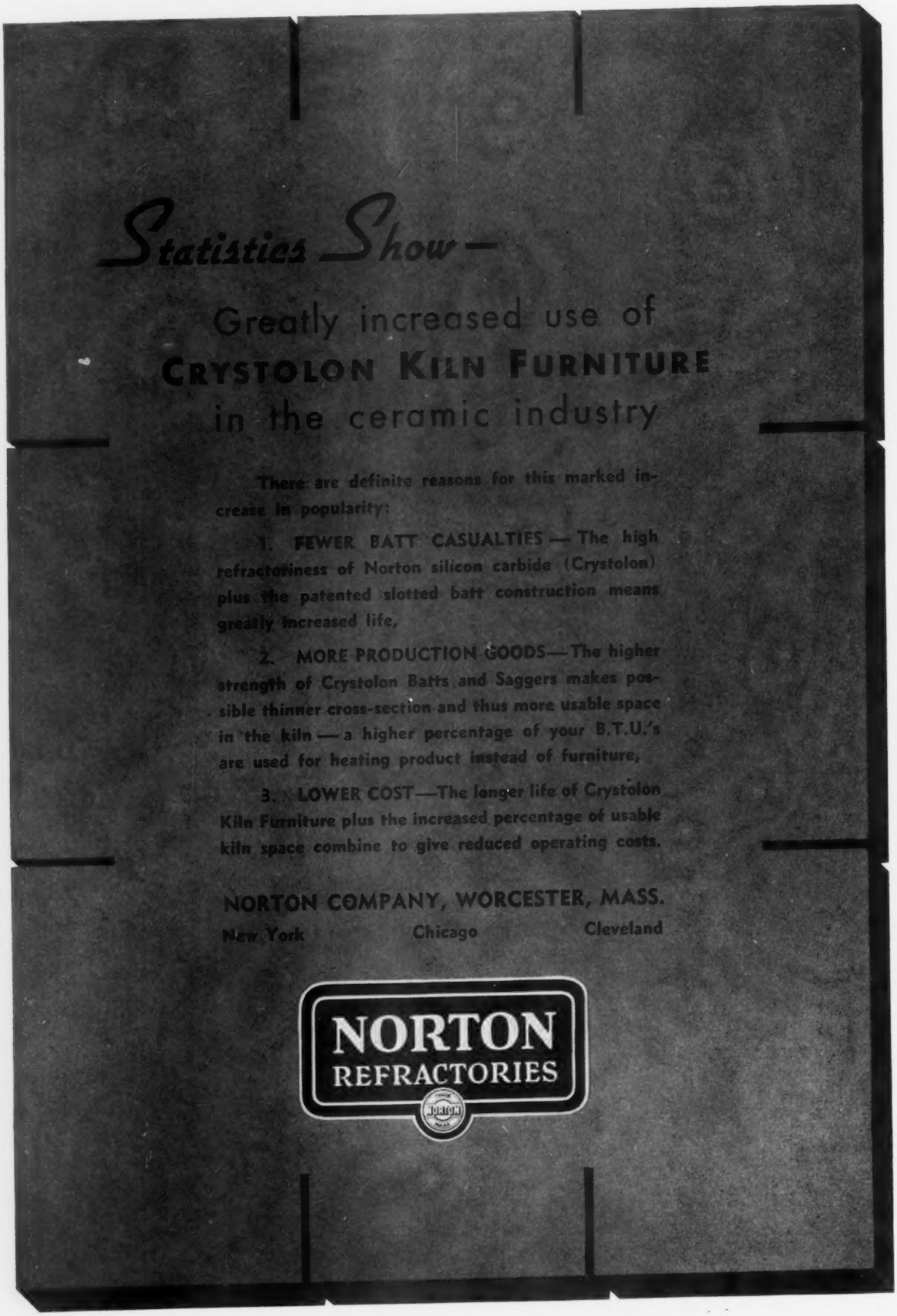
AMONG THE LEADERS in the ceramic finishing field, DeVilbiss Spray Equipment is the accepted standard of product finishing efficiency and economy. These famous manufacturers have been DeVilbiss users for years—and they're still buying DeVilbiss Equipment. They know from their *own* experience that they can depend on *DeVilbiss' 50 years' experience* for ceramic spray equipment of the correct design, quality construction and profitable service. Follow the leaders.
The DeVilbiss Company, Toledo, Ohio.
DEVILBISS SPRAY SYSTEMS
KOHLER OF KOHLER
"Standard" PLUMBING FIXTURES


Statistics Show—
Greatly increased use of
CRYSTOLON KILN FURNITURE
in the ceramic industry
There are definite reasons for this marked increase in popularity:
1. FEWER BATT CASUALTIES — The high refractoriness of Norton silicon carbide (Crystolon) plus the patented slotted batt construction means greatly increased life,
2. MORE PRODUCTION GOODS—The higher strength of Crystolon Batts and Saggers makes possible thinner cross-section and thus more usable space in the kiln — a higher percentage of your B.T.U.'s are used for heating product instead of furniture,
3. LOWER COST—The longer life of Crystolon Kiln Furniture plus the increased percentage of usable kiln space combine to give reduced operating costs.
NORTON COMPANY, WORCESTER, MASS.
New York Chicago Cleveland
NORTON
REFRACTORIES

Abrasives
Carborundum Co. (*Carborundum and Aloxite*)
Celo Mines, Inc. (*Almanite Garnet*)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Norton Co. (*Alundum-Crystolon*)

Air Conditioning Systems
Frazier-Simplex, Inc.

Aloxite (Refractory Products)
Carborundum Co.

Alumina (Hydrate and Calcined)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

Alumina (Fused) Brick and Tile
Electro Refractories & Alloys Corp.
The Vitro Mfg. Co.

Aluminum Oxide (Calcine)
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Aluminum Oxide (Fused)
Carborundum Co.
Electro Refractories & Alloys Corp.
Harshaw Chemical Co.
Norton Co.
The Vitro Mfg. Co.

Alundum (Refractory Products)
Norton Co.

Ammonium Bicarbonate
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Solvay Sales Corp.

Ammonium Bifluoride
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Ammonium Carbonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Antimony Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Antimony Sulphide
Edgar Plastic Kaolin Co.
Foote Mineral Co.
The Hommel Co., O., Inc.

Arches (Interlocking, Suspending, and Circular)
Frazier-Simplex, Inc.
Green, A. P., Fire Brick Co.

Arsenic
Drakenfeld, B. F., & Co.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.

Automatic Brick Car Loaders
Lancaster Iron Works, Inc.

Ball Mills
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
McDanel Refractory Porcelain Co.
The Vitro Mfg. Co.

Ball Mills (Laboratory Type)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Barium Carbonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Foote Mineral Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Basic Oxides
Porcelain Enamel and Mfg. Co.

Batch Systems
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
National Engineering Co.

Batts
Carborundum Co. (*"Carbofrax Aloxite"*)
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Alundum-Crystolon*)

Benders (Bar)
Ransome Concrete Machinery Co.

Beryl
Foote Mineral Co.

Bichromate of Soda
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Bitstone
Potters Supply Co.

Blocks (Refractory)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Louthan Mfg. Co.
Norton Co.
The Vitro Mfg. Co.

Body Stains
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Bone Ash
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Borax
American Potash & Chemical Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Borax Glass
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boric Acid (Anhydrous)
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boric Acid (Crystal, Granular, or Powder)
American Potash & Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boron Carbide
Norton Co

Brick Machines (also Barrows, Molds)
Lancaster Iron Works, Inc.

Brick (Refractory)
Carborundum Co. (*"Carbofrax Aloxite"*)
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Norton Co.
The Vitro Mfg. Co.

Buckets (Concrete, Elevator)
Ransome Concrete Machinery Co.

Cadmium Sulphide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Carbofrax (Refractory Products)
Carborundum Co.

Carbonates (Barium, Lead)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Castings
Lancaster Iron Works, Inc.

Castings (Abrasive Resisting)
Bethlehem Steel Co.

Caustic Potash
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.

Caustic Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Cements
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Norton Co.
Pennsylvania Salt Mfg. Co.

Ceramic Chemicals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Ceramic Specialties
American Lava Corp.

Cerium Oxide
Drakenfeld, B. F., & Co.
Foote Mineral Co.

Chromite (Natural Chromate of Iron)
Foote Mineral Co.

Chromium Oxide
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Clay (Ball)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Bentonite)
American Colloid Co.
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.

Clay (Block)
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Clay (China)
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay—Cleaners, Feeders
Lancaster Iron Works, Inc.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.

Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Metal & Thermit Corp.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
Spinks, H. C., Clay Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Fire)
Denver Fire Clay Co.
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
United Clay Mines Co.

Clay (German Vallendar)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Kentucky Clay Mining Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Clay (Micronized)
Porcelain Enamel and Mfg. Co.

Clay Miners
American Colloid Co.
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Potters)
Denver Fire Clay Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Process Equipment)
Lancaster Iron Works, Inc.
National Engineering Co.

Clay (Sagger)
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay-Slip (Albany)
Hammill & Gillespie, Inc.
United Clay Mines Corp.

Clay (Wad)
Kentucky Clay Mining Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Wall Tile)
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Cleaners
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.

Cleaners, Chemical
Harshaw Chemical Co.
Pennsylvania Salt Mfg. Co.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Cobalt Sulphate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
National Paint & Manganese Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Concrete (Chutes, Grouters)
Ransome Concrete Machinery Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
National Engineering Co.

Copper Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Corhart
Corhart Refractories Co.

Cornwall Stone (Imported)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Crucibles (Filter, Melting, Ignition)
Carborundum Co.
Denver Fire Clay Co.
Norton Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

Cutters (Bar)
Ransome Concrete Machinery Co.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Disintegrators
Lancaster Iron Works, Inc.
National Engineering Co.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enamelers' Borax
Porcelain Enamel and Mfg. Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
Hardinge Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
National Paint & Manganese Co.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

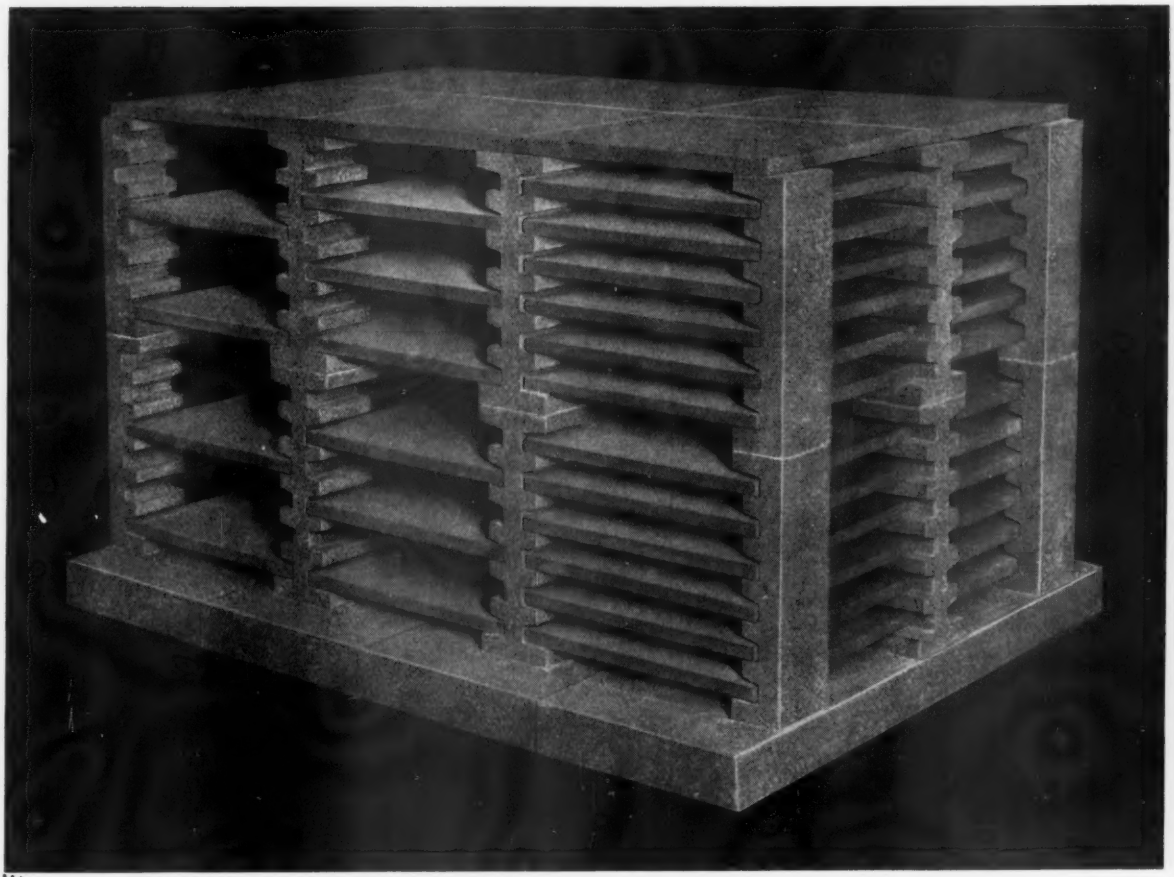
Filter Fabrics
Metakloth Company

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Denver Fire Clay Co.
Great Lakes Foundry Sand Co
Green, A. P., Fire Brick Co.
Spinks, H. C., Clay Co.

Flint
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Great Lakes Foundry Sand Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.



Floating Construction using Electro shelf-posts and Electro batts (left) 5″ apart, (center) 3⅛″ apart and (right) 1¾″ apart.

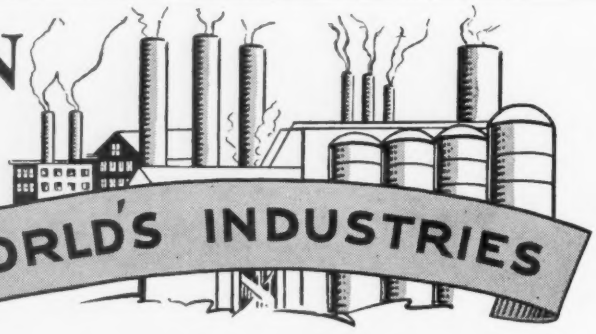
In keeping with the progress of the pottery industry—

Electro's *Floating Construction* has been designed to give greater batt life by relieving stresses and strains. Floating construction also affords greater flexibility in setting ware of different heights, thereby increasing the amount of ware per car.

ELECTRO REFRACTORIES AND ALLOYS CORPORATION

ANDREWS BUILDING • BUFFALO, NEW YORK

A. P. GREEN
REFRACTORY PRODUCTS



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Leadership has resulted from adherence to highest standards. Almost inexhaustible deposits of the finest Missouri fire clays assure uniform quality. Into every refractory product goes painstaking research and years of experience.

Every step in product development is carefully planned and tried. Every product is thoroughly tested in service before it is ever placed on the market.

Products are laboratory controlled—rigidly tested at every stage of production. Manufacturing facilities are unsurpassed. A staff of trained and experienced engineers safeguard the application of each A. P. Green refractory to the needs of the user.

These are the reasons why "A. P. Green Refractory Products Serve the World's Industries."

Write for a free copy of "The Intimate Life of a Missouri Fire Brick."

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SUPER DUTY BRICK
HIGH ALUMINA BRICK
INSULATING FIRE BRICK
PLASTICS
MORTARS
CASTABLES

A. P. GREEN FIRE BRICK CO.
THE MOST ADVANCED FIRE BRICK PLANT IN THE WORLD
MEXICO, MISSOURI U. S. A.

CLAYS
English China and Ball

TALCS
for

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CERAMIC BODIES
SAGGER USES

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Cornwall Stone : Barium Carbonate
Zinc Oxide : Enameling Clays : Etc.

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Importers since 1848
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Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.
The Hommel Co., O., Inc.

French Flint
Maxson, Elwyn L.
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Swindell-Dressler Corp.

Furnaces, Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Sand
Great Lakes Foundry Sand Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Goggles
The Hommel Co., O., Inc.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Granulators
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co.
(*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hoppers (Floor, Tower)
Ransome Concrete Machinery Co.

Hose (Air and Fluid)
The DeVilbiss Co.

Hydrofluoric Acid
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Hydraulic Propellers
Denison Engineering Co.

Iron Chromite
Edgar Plastic Kaolin Co.
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kellog AA Refractories
Electro Refractories & Alloys Corp.

Kilns, China (Decorating)
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Kilns- (Electric, Circular, Tunnel)
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.

Kyanite
Celo Mines, Inc.

Kryolith (see Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.

Lehrs
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick, and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Hardinge Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.
The Vitro Mfg. Co.

Lithium Carbonate
Drakenfeld, B. F., & Co.
Edgar Plastic Kaolin Co.
Foote Mineral Co.

Lithium Minerals
Foote Mineral Co.

Loaders (Bucket)
National Engineering Co.

Magnesia (Fused)
Electro Refractories & Alloys Corp.
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote Mineral Co.
The Hommel Co., O., Inc.

Magnesium Carbonate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.
The Vitro Mfg. Co.

Manganese Dioxide
Drakenfeld, B. F., & Co.
Edgar Plastic Kaolin Co.
Foote Mineral Co.
National Paint & Manganese Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.

Masks (Breathing)
The DeVilbiss Co.
Drakenfeld, B. F., & Co.
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Micronized Products
Porcelain Enamel and Mfg. Co

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.
The Vitro Mfg. Co.

Mixers
National Engineering Co.
Ransome Concrete Machinery Co.

Mixers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)
Lancaster Iron Works, Inc.
Ransome Concrete Machinery Co.

Mixers (Laboratory)
Lancaster Iron Works, Inc.
National Engineering Co.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace) (Laboratory)
Carborundum Co. (*Carbofrax*)

Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Hardinge Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.

Mullers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Edgar Plastic Kaolin Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nepheline Syenite
Great Lakes Foundry Sand Co.

Nickel Salts
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
National Paint & Manganese Co.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Pins
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg Co.

Placers (Concrete Pneumatic)
Ransome Concrete Machinery Co.

Placing Sand
Great Lakes Foundry Sand Co.
United Clay Mines Co.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Potters Wheels
Denver Fire Clay Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Frazier-Simplex, Inc.

Pug Mills
Lancaster Iron Works, Inc.

Pyrites (Natural Iron Sulphide)
Foote Mineral Co.
The Hommel Co., O., Inc.

Pyrometer Tubes
Carborundum Co.
Electro Refractories & Alloys Corp.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
Green, A. P., Fire Brick Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
Louthan Mfg. Co.

Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
American Lava Corp.
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
Norton Co.
Titanium Alloy & Mfg. Co.

Respirators
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal and Thermit Corp.
National Paint & Manganese Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Helmets
Willson Products, Inc.

Sandblast Sand
Great Lakes Foundry Sand Co.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Screening and Magnetic Separators
National Engineering Co.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheaves (Tower)
Ransome Concrete Machinery Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Edgar Plastic Kaolin Co.
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Silicon Carbide
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.

Slab Pushers—Hydraulic
Denison Engineering Co.

Slabs (Furnace)
Carborundum Co.
Electro Refractories & Alloys Corp.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Uranate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
National Paint & Manganese Co.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spraying Equipment
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spurs
Louthan Mfg. Co.
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co
Lancaster Iron Works, Inc.

Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Green, A. P., Fire Brick Co.
Norton Co.

Tile (Wall)
Denver Fire Clay Co.
Green, A. P., Fire Brick Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
National Paint & Manganese Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Towers (Concrete, Concrete Elevating, Steel Elevating)
Ransome Concrete Machinery Co.

Trisodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
Green, A. P., Fire Brick Co.
Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Uranium Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Uranium Oxide (Yellow-Orange-Black)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Water Softening Plants
Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Co., Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
National Paint & Manganese Co.
The Vitro Mfg. Co.

Zircon
Edgar Plastic Kaolin Co.
Foote Mineral Co.
The Hommel Co., O., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Zirconium Oxide
Foote Mineral Co.
The Hommel Co., O., Inc.

Zirkite (Natural ZrO_2)
Foote Mineral Co.

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THE HARSHAW CHEMICAL CO.

General Offices and Research Laboratories: 1945 East 97th St., Cleveland, Ohio

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COLORS

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For Glass:—Enamels; Vitrifiable Colors for Banding, Spraying, and Screening; Printing Colors; Fluxes; Batch Colors.

Decorating Supplies:—Printing Tissue; Screening Oils, French Fat Oil, Oil of Copaiba, Balsam Fir, Damar Varnish; Brushes; Knives and Spatulas; Grinding Mills.

CHEMICALS

Aluminum Hydrate
Ammonium Carbonate
Antimony Oxide
Antimony, Black Needle
Barium Carbonate
Barium Chromate
Bone Ash
Cadmium Carbonate
Cadmium Oxide
Cadmium Sulphide
Calcspar
Chrome Oxide, Green
Clay, Vallendar
Cobalt Oxide, Black
Cobalt Sulphate
Copper Oxides
Iron Chromate
Iron Oxides
Kryolith
Lead Chromate
Magnesium Carbonate
Manganese Dioxide
Nickel Oxide, Black
Nickel Oxide, Gray
Nickel Sulphate
Potassium Bichromate
Potassium Nitrate
Potassium Permanganate
Powder Blue
Rutile, Powdered
Selenium
Sodium Aluminate
Sodium Antimonate
Sodium Bichromate
Sodium Silicate
Sodium Silico Fluoride
Sodium Uranate
Tin Oxide
Titanium Oxide
Uranium Oxide, Orange
Uranium Oxide, Yellow
Zirconium Oxide

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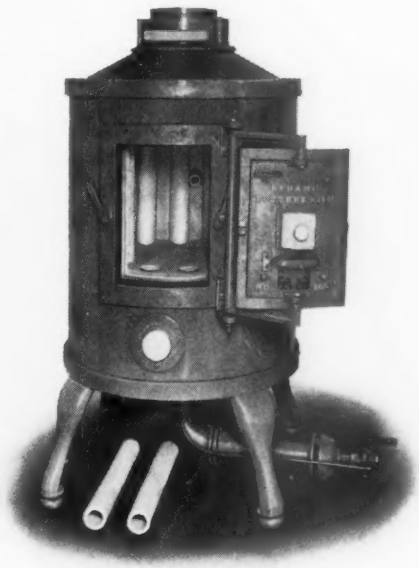

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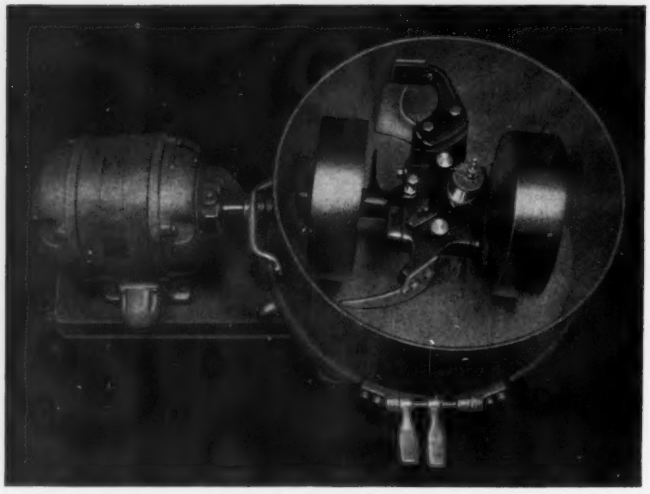

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